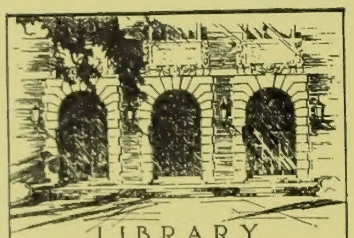

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# AFETY

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. . . see page 25

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MARCH 1953

16

# FLYING SAFETY

UNITED STATES AIR FORCE

THE LIBRARY OF THE
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**TIME and PLACE**

. . . see page 25

# Minus Oxygen Equals X

*Air Force Regulation 60-16 sets forth the rules for use of oxygen in flight. It is part of your duties, as pilot of the aircraft, to be familiar with the provisions of this regulation; and to enforce the regulation during periods of flight.*

*Don't stretch your luck. If in doubt, use oxygen. Before every flight, include the oxygen system as part of your regular preflight check. Be sure there are enough masks aboard, and that they are in working order. You never know when you, and your passengers, may need oxygen.*

## . . . Lack of Oxygen Makes Jack a Dull B

9 NO. 3 MARCH 1953

# FLYING SAFETY

rtment of the Air Force The Inspector General USAF
Major General Victor E. Bertrandias,
Deputy Inspector General

☆

Brigadier General Richard J. O'Keefe, Director
Directorate of Flight Safety Research
Norton Air Force Base, California

☆

Lt. Col. John R. Dahlstrom
Supervisor of Flight Safety Publications

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**If you've ever had an accident, your story is in these files. See "This is Flying Safety," page 25.**

***Now It Can Be Sold . . .*** Starting with this issue, the Government Printing Office has put FLYING SAFETY magazine on the open subscription list. Now you can have your own personal copy of FLYING SAFETY mailed to you each month for the reasonable price of $2.50 per year. Send your subscription to the Superintendent of Documents, Washington 25, D. C., enclosing check or money order. Add seventy-five cents for overseas mailings. Single copies may be obtained for twenty-five cents.

***Flying the Thunderstorm*** (page 9) may be "old hat" to some of you more elderly hands, but we feel that this kind of information cannot be repeated too often for the younger set. The thunderstorm holds no terror for the pilot who is physically and mentally prepared to joust with it. *Tailor Made Weather* (page 14) gives you the Weather Service picture on specialized weather.

☆ ☆ ☆

***Well Done***—FLYING SAFETY's Well Done feature has become famous throughout the Air Force. The editors feel that only exceptionally outstanding feats of airmanship are worthy of comment, and standards are necessarily high. Keep your weather eye out for *outstanding* examples of airmanship, and send them to us, with the *complete* story of the action, plus photographs.

# ....TAKE THE HIGH ROAD

***Call it minimal flight path, pressure flying, or going direct, it all boils down to knowing how to find the best winds aloft. A good tail wind is a joy to all flying men.***

EVERY pilot dreams of a Never-Never land where the winds are always behind him, and the weather is always CAVU. Until the time when we reach that Promised Land, we have to make the best of what we have here below, and use our noggins to hunt those tail winds. To date, little if anything has been done about declaring a constant state of CAVU.

For many years pilots and metro boys have bitten the ends of pencils and scratched their balding domes to find the best way to fly from here to there, the fastest with the leastest fuel. What they were looking for was the shortest time flight path between two airports separated by wide expanses of air. Naturally, the ultimate was the maximum use of tailwinds.

Recently, the USAF, after researching this theory, came up with a formula which has proven highly successful from a practical standpoint. The formula, which is highly mathematical, and which uses Geostrophic winds, Bellamy drift, PLOP, and other mystical jargon, selects the route under variable wind conditions most conducive to the quickest flying time and the least amount of fuel. To those of you who understand the fuel flow of a jet engine, the importance of this planning is obvious.

The key to the minimal flight path theory is knowing the direction of the wind and its velocity; and that winds follow the isobars clockwise about a high pressure center, and counter clockwise about a Low. (In the Northern Hemisphere, that is, son.)

Of course, there are some limitations to the use of this system. Unless the winds are of rather high velocity, and non-uniform in strength, your great circle course will be better to use, as this in itself will be the minimal flight path. However, over on the Atlantic side, you have a different cup of tea. Here we have a great amount of metro activity, and you can really use the MFP (minimal flight path).

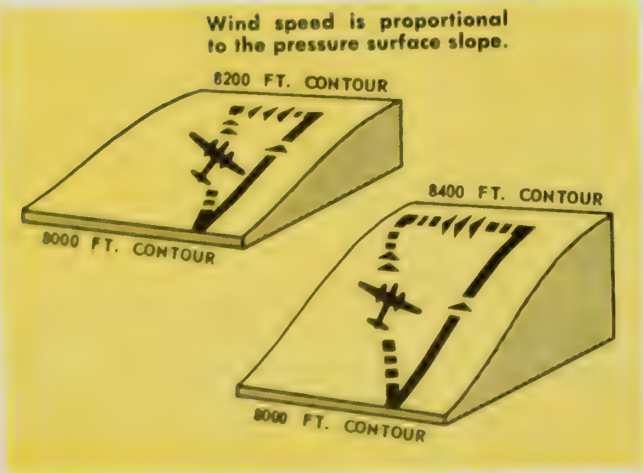
Let us suppose that we are planning a flight from Belfast to tha
haven of beautiful women, Newfoundland. The first thing we should
do is to wrap a sheet of paper in
tube around the globe, and tangen
(at right angles) to the great circl
route between these two points. Whe
we unfold this tube, and spread it ou
we have what the cartographers ter
an "oblique-mercator" projection
the proposed route. Now the met
chap plots the great circle route
this map, locates the existing pressu
canters, and plots these pressure pa
terns for any chosen flight altitud
When he finishes this plotting,
must consider two factors. Strangel
enough these factors are crosswin
and tailwind (metro men never ca
winds names like Maria).

The meteorologist then conside
crosswind effect. Here the drift co
rection angle may be large, and ma
vary from right or left of the gre
circle flight path, yet the net dri
may be small. If it was necessary
compensate only for drift by flying
single heading, fuel and time cou
be saved by eliminating the crabbi
of an airplane. Crabbing to hold
great circle track would cut down t
speed of the airplane considerably.

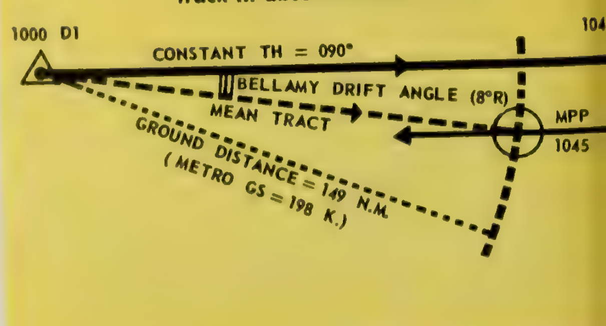
Now at this point, metro decid
whether a single heading track w
do the trick, or whether the sing
heading track must be corrected
compensate for tailwind.

It has been proven that the syst
is far more accurate than any oth
known method. If the meteorolog
finds that the MFP cuts through so
gloomy weather, he can prepare
new MFP from any point on
original track. Each major leg
the new track will be a separate mi
mal path.

**Wind speed is proportional to the pressure surface slope.**



**Bellamy drift provides a mean track in absence of other aids.**



o summarize, the minimal flight
nique is based on the theory that
general wind circulation is deter-
ed by pressure distribution in the
osphere. This pressure distribu-
is measured at strategically lo-
l weather stations, where weather
charts may be prepared. With a
ılated choice of flight routes to
maximum advantage of the wind-
pattern, flight time is consider-
reduced. In addition, fuel con-
ption is decreased, and aircraft
crew fatigue is reduced, points
utmost concern to maintenance
le and flight surgeons. In addi-
reduced requirements for fuel
enable aircraft to carry greater
oads over longer distances.

ctually, pressure flying is a sim-
technique that enables pilots to
e the best possible use of winds
at various flight altitudes. One
e reasons that pressure pattern
g is simplified, is because pres-
information is more easily ob-
d, and is more accurate than
o winds.

or discussion purposes, pressure-
ern flying falls into two cate-
s; as an aid to dead reckoning,
as an aid to flight planning. By
ication of the pressure pattern
ula to inflight use, the cross-wind
ts can be utilized to calculate
sure lines of position (PLOP),
to determine drift over a past
d of time. This last use, which
own as "Bellamy drift," is an
llent aid to navigation, as it gives
an extremely accurate reading
ctual wind effect. In the flight-
ning phase, the pressure pattern
y enables you to plan your flight
to take the best tail-wind push.
so allows you to simplify your
gation problem by setting up a
single heading flight, and to calculate the best path of your airplane from takeoff to destination in terms of minimum time in the air.

The basic principles behind pressure-pattern flying are dependent upon your familiarity with pressure lines of position, Bellamy drift, single heading flight, and the minimal flight path. In order to understand these factors, you must know a few things about the causes, effects and characteristics of the geostrophic wind, which is explained lucidly in AF Manual 51-43 (Air Navigation for Pilots).

The constant pressure charts show the various heights of pressure surfaces above sea level. The lines connecting the equal points of pressure form a contour line, every bit like the contour lines you studied in basic map reading. In fact they are called pressure contours, and they may be interpreted in the same manner.

On a ground map, wherever you see the contour lines close together, you will find a steep slope. Where you see lines of pressure close together, you will find steep slopes of pressure surfaces.

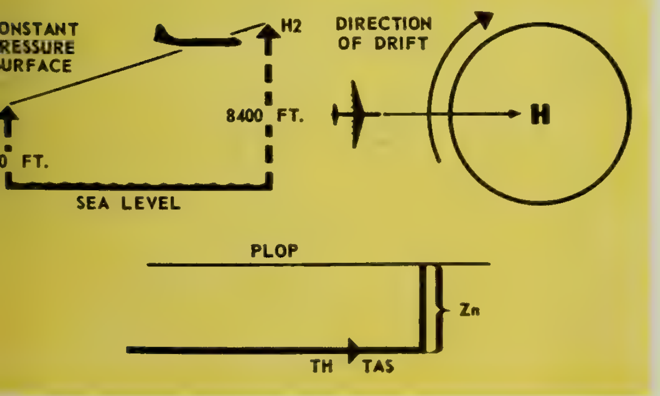
Pressure contours and isobars are essentially the same. These contours are isobars drawn on a constant pressure surface, and the *winds tend to blow along the contours* just like they blow along isobars. Also, the same rules for estimating the direction and speed of the wind from the examination of isobars hold true on the constant pressure chart.

The speed of the wind is proportional to the slope of the pressure surface, so where you see the contour lines close together, you'll find high winds.

One thing to keep in mind, is that there is no effective way of determining when the airplane is flying in the direction of the maximum slope, so windspeed cannot be determined. However, the drift effect can be determined. The drift effect is directly proportional to the slope flown. If you fly parallel to the contours, you do not get the tailwind effect, but you may experience either a head wind or cross wind effect. The cross wind is proportional to the slope flown in flight measured along the flight path of the airplane, but the entire wind effect is proportional to the slope measured perpendicular to the contours.

Knowing these things is part of your job as an aircrewman, as this kind of knowledge gives you confidence in yourself. And in closing, it shows you that Air Weather Service is an important part of the worldwide USAF team, and that they are pretty much on the ball when it comes down to brass tacks! ●

Aircraft drifts to left of track due to wind circulation.



"Ptarmigan Flight" is just another wa of saying over the North Pole. Eac mission demands the kind of briefin being given here to old Alaska hand of the 58th Strat. Rec. Sq. (Weather)

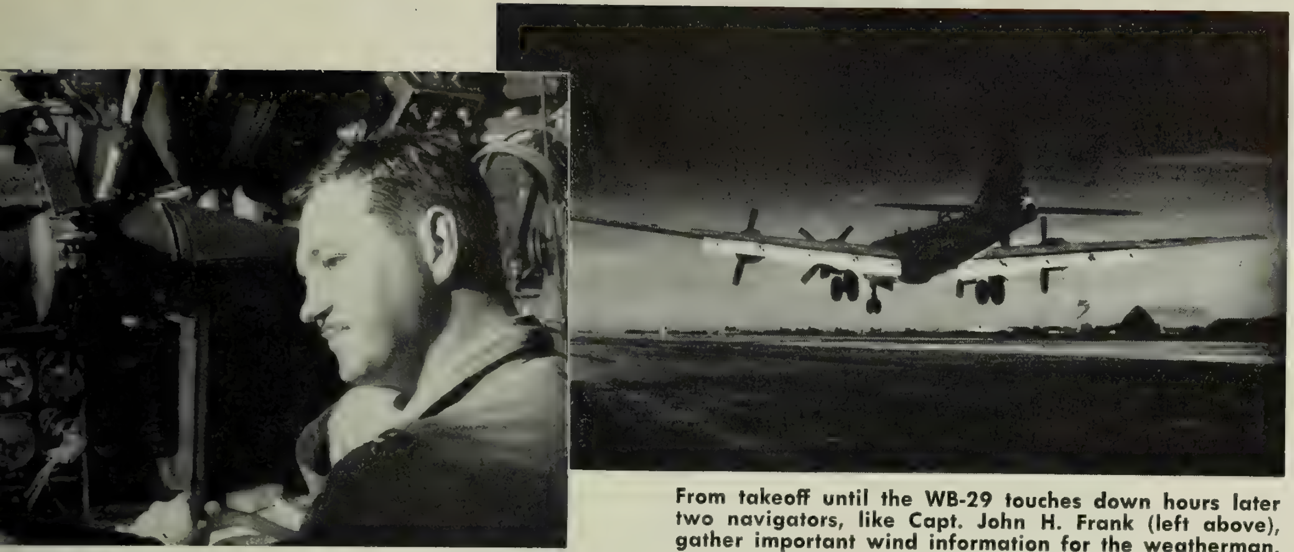
# .....over WAS

## Weather Recon Makes Flyi Safety Pay Off by Emphas ing Crew Training and A craft Preparation.

At 31,000 feet, this is how the top of a hurricane appears.

THE shining silver WB-29 ta slowly into a circle of floodlig the propellers four silver disks revolving light. The airplane cre to its parking spot, and comes t full stop with a slight squeal brakes. The engines growl deeply a few seconds, cough once or tw and then are still. The silence of night is broken by the slam of the pistons dropping the twin bomb- doors, and one by one the flight-we crew of weathermen drop from belly of the big bird.

This can be Eielson AFB on edge of the Arctic Circle, it car Kindley AFB in the Bermuda tro it can be Yokota in Japan . . . it be California. Day after day crews of the strategic reconnaiss squadrons ply their way across w and water . . . 2600 . . . 2800 3000 nautical miles . . . 12 . . . . . 16 hours in the air! These r squadrons are covering the w plotting weather from the North to the Equator to gather, log an



From takeoff until the WB-29 touches down hours later two navigators, like Capt. John H. Frank (left above), gather important wind information for the weatherman.

# WATER

**By Maj. R. L. Crozier, USAF, Chief Aircraft Engineering Div. Hqs., Air Weather Service**

t weather information for the
, so that you as an aircrewman
nave at your fingertips the best
er information of any flying
in the world.

### Recon Squadrons

Eielson AFB the 58th Strat Re-
ies the Ptarmigan run up into
nely wastes of the North Pole,
he Loon Echo track over the
g Sea to Shemya. Leagues of icy
water lie below . . . little in the
of navigational aids and rescue
ties at any time. Spread through-
e world are other strategic re-
issance squadrons, each doing
nely bone-tiring job day after
Down at Kindley AFB, Bermuda,
3rd Strat Recon flies the Gull
and the Gull Hotel tracks. In
inter months it's the Gull Item
to the north; from July to
nber, they fly the Gull Hotel
to the south, the hurricane
where storms are followed and
inted for your safety.
on Guam, consorting with the
ys, is the 54th Strat Recon, fly-
ulture Metro and Vulture Lima.
are the typhoon hunters track-
e big winds to the north and
south. Stateside, at McClellan
in California, the 55th Strat
flies the Lark Golf and Lark
Foxtrot tracks out into the lonely stretches of the Pacific; while at Yokota AFB in Japan, the 56th Strat Recon flies the Buzzard Delta towards the Arctic and the Buzzard King, tracking to the West over Korea. Down near the beach at Waikiki, the 57th Strat Recon out of Hickam flies the Petrel Coca and Petrel Delta tracks to the north and to the northwest.

Because each recon flight is over water or barren wasteland, the subject of flying safety is of primary importance to the supervisors and to the crews who actually fly the runs. By the very nature of the mission each strat recon flight takes a lot out of the airplane and its crew.

In the first place, each normal mission averages 2700 nautical miles and lasts from 12 to 16 hours. The outbound track is usually flown at 1500 feet altitude, with a return at 18,500 feet. Add to this typhoon and hurricane penetrations at 10,000 feet with descents made to 1500 feet inside the disturbances and it is evident that flying safety is a must.

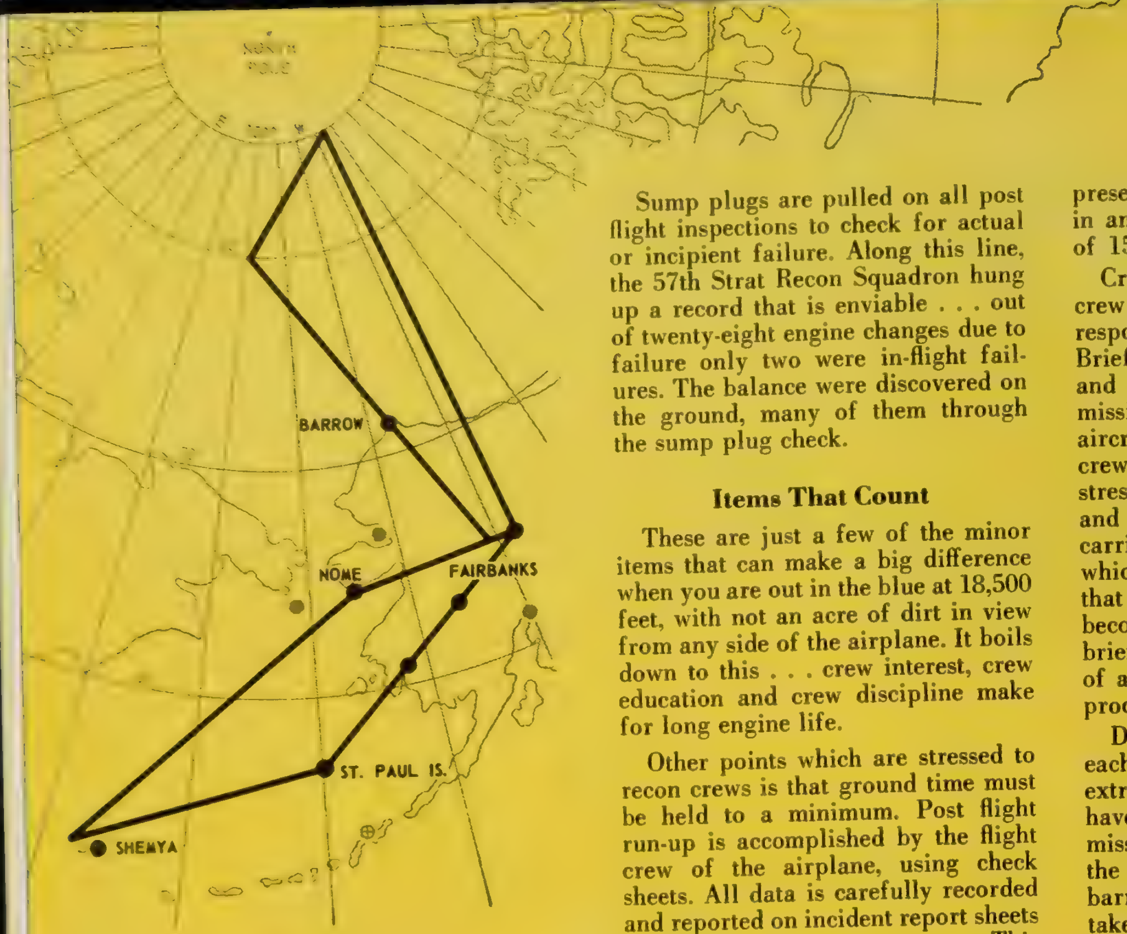
In 1951, Air Weather Service estimated that the government was saved about $1,900,000 on engine life, with an added $750,000 in 1952. These savings were realized through exacting engine conditioning procedures, operational procedures improvement and complete coordination between flight and ground crews.

The average service life of AWS R-3350 engines between overhaul for 1952 was 448 hours, with 31 per cent of the engines used operating for the full allowable time of 600 hours. As a result of this, the AWS has received from Air Materiel Command permission to operate their WB-29 engines 700 hours between overhauls using only 25 PSI as the minimum compression value required. Air Weather Service proved to AMC that its superior engine maintenance and operational procedures would stand the test between changes . . . and it has paid off to the tune of many dollars a year savings to the taxpayers. This in itself is a worthwhile story in the overall saga of strat recon operations.

### Maintenance Record

There is nothing hush-hush or "superman" about this outstanding maintenance record. The secret is just common sense adherence to tech orders plus rigid crew discipline . . . any outfit can do the same if they follow the rules to the letter . . . and impress it on all crew members, air and ground, that treating those engines with fatherly care pays off in the long run, in terms of flying safety.

In the first place, AMC standards



receive most careful adherence in all phases. One item of interest to all engineers is the fact that oil is changed every 100 hours, using an oil dilution and flush-out procedure during change. One of the big sources of engine failures on the B-29, that of main bearing failure, was greatly reduced by this procedure. Another bug that was licked by the strat recon engineering people was the failure of exhaust valves. This was done through pilot education and changes in operating procedures. Recon crews now use auto-rich mixture above 2100 RPM. In addition to licking that exhaust valve problem, it has been proven that fuel consumption is not increased.

Other maintenance methods that have resulted in longer engine life on the strat recon airplanes include continued emphasis on the point that the use of dial indicators is mandatory for valve checks, and that spark plugs must be carefully installed. This last item seems to be the source of much trouble in B-29 engines. The recon people insist that each plug be bomb-tested and gap checked prior to installation, that each plug bushing be cleaned so the plug can bottom properly, and that each plug be torqued correctly.

Sump plugs are pulled on all post flight inspections to check for actual or incipient failure. Along this line, the 57th Strat Recon Squadron hung up a record that is enviable . . . out of twenty-eight engine changes due to failure only two were in-flight failures. The balance were discovered on the ground, many of them through the sump plug check.

### Items That Count

These are just a few of the minor items that can make a big difference when you are out in the blue at 18,500 feet, with not an acre of dirt in view from any side of the airplane. It boils down to this . . . crew interest, crew education and crew discipline make for long engine life.

Other points which are stressed to recon crews is that ground time must be held to a minimum. Post flight run-up is accomplished by the flight crew of the airplane, using check sheets. All data is carefully recorded and reported on incident report sheets to augment Form I write-ups. This precludes additional ground checks by the ground crews. Pilots do not make full-power ground checks except when an instrument takeoff is called for and then at the discretion of the aircraft commander. Normally the full-power check is obtained during the first third of the takeoff run. Preplanning is stressed. One engine-time-saver is the procedure of requesting the ATC clearance prior to starting the engines and making the preflight check.

Operating temperatures are held to a minimum not only on the ground but also in flight. When the airplane is being run up on the ground, air and ground crews are trained always to head the ship into the wind. Runup time is held to an absolute minimum. Auto-rich is always used above 2100 RPM, with climb-out at higher than usual airspeeds (200-205 mph).

Another factor that has played a big part in the efficient and safe operations of strategic reconnaissance is gross weight reduction. There is no dead weight aboard a strat recon airplane. Minimum gross load and safety factors are carefully computed. They don't burn fuel to carry fuel. Loads are streamlined to approximately 117,000 gross. Bomb racks are removed, as are bomb-bay tanks and other non-essentials. A survey pointed towards further weight reduction is presently under way that will rea
in an estimated additional reducti
of 1500 pounds of gross weight.

Crew training is stressed, with
crew members being taught to acce
responsibility for safety in flig
Briefings are complete and detail
and take place the day before
mission. Before the actual takeoff,
aircraft commander again briefs
crews. Instrument proficiency
stressed as are emergency procedu
and ditching. Each crew mem
carries a small plastic-encased
which spells out his part in the e
that ditching, bailout or crash land
becomes necessary. He is always
briefed and well-trained, but in
of a minor panic, he has the pro
procedures in his breast pocket.

Ditching drill is held at least
each month by the entire crew. Th
extremely important because, as
have pointed out, every strat re
mission is over the worst terrai
the world . . . either blue water
barren wasteland, where rescue wo
take hours, sometimes even days.

Along the survival line, much
thinking has been done on kee
survival equipment to a usable
mum. Here again, weight is the
ciding factor. It was found that
Arctic recon airplane went out
as much as 2000 pounds of surv
equipment aboard . . . some of
bulky that the crew had tro
crawling around over it. By scree
the actual usability of the equip
on board, this weight was reduce
about one-half. Everything was
to the bone, including rations,
were reduced one-half.

### Flight Safety Stressed

Because of the nature of the
recon mission, because of the im
tance of the mission, and be
there can be no compromise wit
ciency, flying safety is const
stressed among crew mem
through crew training in every
of operation. Strategic reco
sance squadrons fly an equivale
many trips to the moon. Let's lo
just one of the many recon unit
the 56th Strat Recon Squadron
Japan. In 1952 this outfit logge
ter than 12,000 hours over the P
flying in all kinds of weathe
under every known condition.
cruising speed of a B-29, this
about five trips to the moon
return . . . a lot of miles any
you look at it. ●

# HE UPPER AIR CHALLENGE

MINIATURE weather station, dan- ; from a parachute as it floats ward, affords Air Weather Serv- new method of exploring the r atmospheric regions over re- areas of the earth.

own as the dropsonde, this in- ient is parachuted from high alti- ; and explores the upper air ns as its source for weather data.

til the introduction of aerial ier reconnaissance and the em- ment of the dropsonde for ex- ng the upper atmosphere, the ary forecaster was limited to ier information obtained by nd observation stations.

til several years ago, meteoro- al data was obtained primarily se of the mercurial barometer, vet and dry bulb thermometers, ecording anemometer and wind . For upper winds, a hydrogen- l balloon was followed in its with an instrument resembling veyor's transit.

e balloon method of determin- ipper air winds was followed by methods recently developed for ding upper air observations. e new techniques include the of the "Radiosonde" and "Drop- e."

diosonde is a device involving l pressure, temperature and hu- ty measuring instruments which arried aloft from the ground by ee balloon with a radio trans- r attached to relay information ground receiver.

e balloon borne radiosonde is by ground weather stations while dropsonde is employed by recon- sance aircraft operating over long e "weather tracks." The drop- e is designed to be launched from ircraft to obtain the atmospheric sure in millibars, the temperature egrees Centigrade, and the per- age of the relative humidity of mass of air through which it falls.

oday, in certain areas of the d where weather data is not read- available from other sources, her reconnaissance aircraft are ated by the Air Weather Service bserve and report surface and er air weather conditions by flying a fixed track and making weather reports at predetermined positions. In effect, a series of weather stations are originated at each of the fixed positions along the weather track where observations are recorded.

The 56th Strategic Reconnaissance squadron is one of the six recon squadrons which fly these "weather tracks" in search of elusive upper air data. Operating WB-29's flying weather laboratories, the 56th flys over thousands of miles of the Western Pacific in search of upper air data.

Each weather track is about 2600 miles in length, and consists of approximately 26 fixed weather reporting positions. Normally four dropsondes are released at predetermined positions along the fixed track and the data transmitted is transcribed and recorded by the dropsonde operator.

As the dropsonde descends to the surface, it actually is examining a column of air from the altitude of the drop to sea level. In the case of drops made by the 56th, this is usually from 18,000 feet.

As the dropsonde floats to the earth, meteorological data is recorded by three weather measuring devices:

- a twin aneroid cell to measure pressure,
- a bi-metallic temperature element which expands and contracts with changes in temperature, and,
- a human hair hygrometer to determine relative humidity.

A continuous record of data is relayed to a radio listening post in the aircraft by a self-contained transmitter in the dropsonde which sends coded messages designating the readings of the three weather recording devices. As each condition of weather changes a different series of coded signals are transmitted.

The series of coded signals are imprinted on a plastic disk. A record arm which rides on the disk changes its position on the disk in response to changing weather conditions and emits a series of signals. A separate record arm and a separate series of signals are used for each of the three weather elements. As the disk rotates the three record arms, positioned by their response to the weather data, send out the signals, a triple coded series, to inform the listener of the desired weather information. The dropsonde transmits approximately 12 code groups per minute while descending at a rate of approximately 1100 feet per minute.

The instrument is factory checked for accuracy and checked again before each flight by the dropsonde operator. The dropsonde is launched from an airlock chamber in the reconnaissance plane. It is equipped with a static line parachute opening device which "pulls the ripcord" to open the chute.

The coded data received by the dropsonde operator is recorded, and when the drop is over, the information obtained is decoded against a master calibration chart. Data thus obtained is plotted on an adiabatic chart, recorded into usable data which is verified by the aerial forecaster in order to check the validity of the information before it is transmitted over weather communications circuits.

With newer methods being made available, the upper atmosphere is becoming less and less of a mystery to the meteorologist. While the challenge offered by the upper air has not yet been conquered, instruments like the dropsonde offer a method, which in the future, may make meteorological data from the upper air more readily available to the weather forecaster. ●

# When y

**By Major H. A. Jacobs,**
**Weather Recon. Division**
**Headquarters Air Weather Servi**

THE sage advice, "Avoid thunderstorms at all costs" is not very helpful to the pilot who inadvertently gets involved in a large, dark type thunderstorm. When the intrepid aeronaut encounters a storm, he should know the rules and the reasons behind the rules. Advice on flying thunderstorms is "old hat," but the subject is important enough to repeat it again for the new pilots who have yet to encounter this phenomenon of Nature, and for the older types who may have forgotten the rules.

When planning flight through storm areas, keep in mind the "*Three A's*":

- What *Altitude*?
- What *Airspeed*?
- What *Attitude*?

These are the three factors at the head of the list, though everything is important when flying under such severe conditions. There are also pertinent questions, like:

- What is the alignment of storm and terrain?
- What to avoid, besides bumps?
- Choice of course and what to do next?

### Altitude

Lower level altitudes are slightly less turbulent and are chosen whenever terrain permits. Ocean practice has been to fly underneath, which doesn't mean right on the deck. (Visibility isn't good enough.)

You can expect instrument time anyhow in the scud beneath the main base or in the precipitation where you have only vertical visibility. Also, you will be on instruments, if caught in a strong updraft, for you will be carried up into the cloud. As a rule 2000 feet above the surface is taken as the minimum clearance altitude on account of the downdrafts to be expected.

It's the higher altitudes that give the higher turbulence. Your anatomy
may report it's rough at all levels
it is shown statistically that the
tudes around 15,000 feet have, on
average, greater turbulence and
ger up-drafts. The higher altit
have other disadvantages too, aro
the freezing level precipitation s
gets worse and the probability
lightning strike is greater. Likev
heavier hail is to be expected
wing icing would be a maxin
at wing temperatures just b
freezing.

### Choice of Airspeed

Next on the list, *Airspeed, I*
*cated*. Recommended airspeed is
tween cruise and stall with a ma
of 30 to 40 mph above the stal
speed for the altitude flown. T
are several good reasons for this
you know, gusts impose greater l
at higher speeds. A glance at an
celerometer will show why you d
want to hit a big bump at placar
red line speed. The engineers

# into a thunderstorm . . . . .

l that red line speed as the point e structure begins to show signs ailure upon encountering the est bump likely, according to available to them.

e speed limit is chosen to avoid problems, also. The rule, main- 40 mph over normal stall speed, guess, as consideration of the l and gust structure will later . Also present is a possibility high speed stall, which leads to most severe loading condition. such stalls would occur sooner rns, the rule is, maneuvering in lence should not be abrupt.

ere is a very practical reason, why a certain range of airspeed ecified. In turbulent air, the air- l needle flickers rapidly through ge directly proportional to the ness. When you have to fly by an ge reading of the vibrating e, you don't want to crowd the s of the desirable speed. Some s have been published showing limits for a variety of large . They are useful to get the idea, it is more important to know the actual stalling speed and the ine are for your own ship, load altitude.

### What Is Your Attitude?

u are not flying rough air very before the *Attitude* problem s up. For longitudinal attitude, the behavior of an autopilot you'll see why. Pick up an up- and it will put the nose down the airspeed goes up; change to wndraft and the nose comes up the speed falls off. Since the lard model of autopilot is a con- attitude device it is acting as as designed to, but since the s usually alternate, your ride is that on a roller coaster. Since echanism doesn't know anything t airspeed limits, you don't use it.

hat attitude should you take? pilots think it is a good plan to with the storm, changing altitude ly with the elevator to offset the ts of the drafts, using the throttle e same time to maintain airspeed. xtreme action is wanted in either ese controls.

The attitude then should be such as to counter the effect of the airspeed and here you depart momentarily from SOP, that is, you let the altitude take care of itself. The airspeed changes due to attitude can be anticipated from the artificial horizon. The rate of climb indicator is definitely ignored and the sensitive altimeter becomes the rate of climb indicator in strong drafts. The maximum rates recorded on a recent project were 6,000 feet per minute. Extreme as these have proven to be, we'll bet you have heard someone tell of bigger ones.

However, it is not a question of ignoring the deviations from assigned altitude; it's a case of pilot judgment in flying the airplane safely during these displacements forced by nature. The average change in altitude in crossing a storm tends to even out as shown in thousands of traverses on the same project where net change would be but a few hundred feet. When an exceptional displacement was experienced it meant circling in the clear to return to the scheduled altitude. This gives a controlled sawtooth flight path which is desired rather than a roller coaster ride.

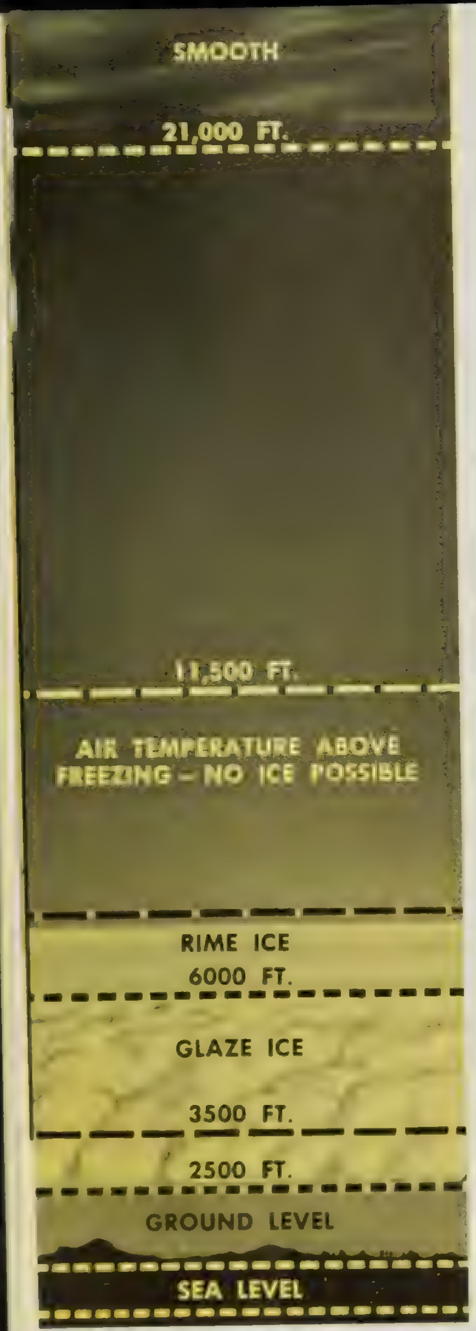
The figures on typical storm measurements indicate drafts of roughly half a mile across as about the maximum. You can figure out from your own airspeed how much change in altitude you are going to get if you hit such a maximum as just mentioned above. More is to be said about this later, but it is obvious that you don't have to worry about being blown out the top. Careless handling, tumbled gyros, vertigo and rumor can account for the tall tales you may have heard about what drafts can do.

***Major Jacobs is a former MATS pilot, with actual thunderstorm flying experience on the Atlantic, Asia, European and Africa-Middle East runs. The Major knows whereof he speaks, and contends that a pilot who has the necessary preparation plus a sound psychological outlook can weather the most mature thunderstorm . . . unless he can avoid it!***

There is more concern about being carried out of the bottom of the storm, which occasionally can happen. This is where the terrain counts. Naturally, the altimeter should be set to the minimum pressure reported en route. Altimeter changes caused by pressure changes in the storm itself can amount to a few hundred feet. It is well worth noting that this is but a tenth the altitude error resulting from wind action crossing mountain ranges.

One thing disconcerting about longitudinal attitude when you first encounter a maximum updraft is the startling readings of the instruments. Moving pictures of the panel verify the fact that the altimeter shows a rate of climb of several thousand feet at the same time that the nose is down and the airspeed is increasing. Just then it may not be natural to control so as to bring the nose up and ease off on the speed. That's the thing to do, though, so that you won't slam into a high speed stall if you should run into a nose gust on the way out. Such an experience is rare; more people have reported a strong downdraft that they could not outclimb. Too low an airspeed is not good in such a climbing attitude since a tail gust gives you a stall that drops the bottom out of things. This is where the minimum of 2000 feet above terrain is useful, plus a horizontal maneuvering distance sufficient to clear obstacles.

Next, discussion about *lateral attitude* is just as provocative. Level heads and level wings seem to be the rule. Whether or not you "pick up a wing" immediately is unimportant. It is important, however, not to go into a high rate turn as the wing goes down. Shallow turns are wanted in rough air skidding around if necessary. Fifteen degrees is considered a



Cross section of a weather situation where soundings have found icing levels.

good bank in turns. The reason is that steep turns invite trouble as the greater wing loading and turbulence increase the stalling speed.

The glider pilots are the ones to ask about the spiral dives which occur at this stage. Their technique of getting out of a thermal in an emergency is to spin down completely stalled. A sink of 20 feet per second is achieved without a high forward speed. Some spectacular losses of altitude are reported when this sink is added to the downdraft velocity. This is brought about because the right spiral of 200 feet or less in diameter kept the glider in the downdraft for over a minute at a time.

There is another meaning of the word "attitude" that you have heard of before. How about your *psychological attitude?* It will certainly be better if you know what to expect and why, but it isn't going to make up for lack of equipment. Maybe you have flown instruments with a primary group, but did you every try it in rough air? A directional gyro is essential and an artificial horizon is desirable. Similarly the question: *Have you got enough power?*

This can be best answered by knowing the performance of your own plane and comparing the records of similar airplanes, under storm conditions.

To review, for a moment, the processes behind the choices being made:

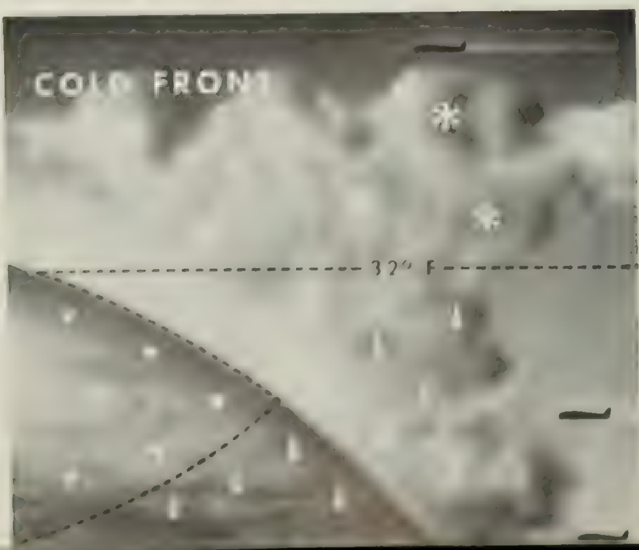
A pilot would like to avoid the worst part of the storm. If he had a radar he could scan the surrounding turbulent clouds and take a course to avoid the big fat echo he calls the core. In fact, measurements show that if he can stay over three miles from such echoes, he will not experience thunderstorm conditions even though he still is on instruments. That is, the big echo in clouds comes from the precipitation area and the findings show the most activity goes with the heaviest precipitation. It is not accidental that the precipitation goes along with the strongest drafts since the vertical cloud is built upon the energy coming out of the condensation process.

When you see a thunderstorm in the mature period of development it is a fully developed cumulonimbus complete with anvil top and squall line at the surface. The turbulence therein will be but little different from the initial stage from which it grew in about 20 minutes. In fact, as long as unstable conditions remain, some parts of the cloud will continually be in the most active building stage, usually on the leading edge.

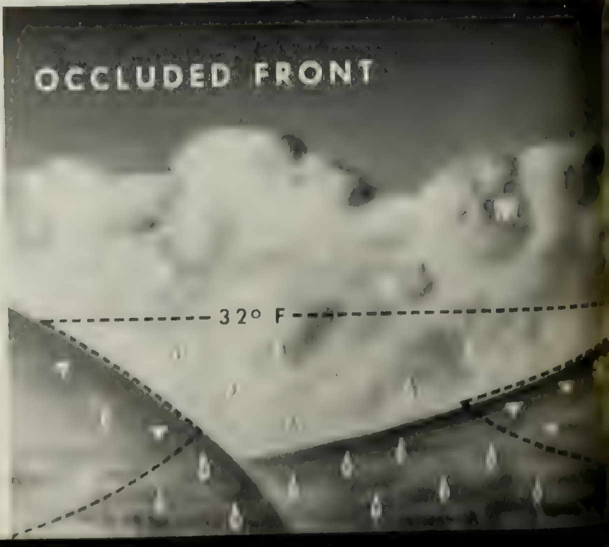
Only when there is no more warm moist air being fed into such a thunderstorm does it reach a dying stage. By that time, the cloud may look about the same but the traverse encounters mostly downdrafts and turbulence on a reduced scale. Actually, if you could follow the entire life cycle of a storm visually you would pick this last stage as the time to fly through it with the least trouble.

When conditions are right, the instability is "triggered" — the forecaster says—and the cumulus boils over, as it were. The pilot can sense this if he sees the turbulent cloud while approaching in the clear. This building stage of updrafts is already very rough and it takes the part of the cloud but a few minutes to pass to mature stage with both up and down

Higher altitudes can mean more turbulence. Keep storm penetration low.



A good rule of thumb to observe in thunderstorm flying is avoid dark areas



with various forms of precipi-
present. Meanwhile new cells
owing, some of them created by
rafts of the same storm. Only
the supply of moist air is cut
ll the storm start dying out.
then on the turbulence de-
s although strong downdrafts
continue in the cumulus of
itation.

### Avoid Dark Areas

enever a storm whose immedi-
story is unknown is encoun-
n flight, the pilot has to be the
udge. If he has just a close-up
o go on, the rule is *Avoid Dark*
These are the regions of dens-
uds and probably heaviest pre-
ion, though all clouds look
if shielded from light. Some
ecesses may be just shadowed
main cloud and its overhang-
ouds; some pilots profess to
e main cloud by a slight differ-
n the color. Glider pilots in
g under a cumulus looking for
port a difference in color, also.
ind the maximum updraft leads
blackest part of the base when
ecipitation is yet present. Light
pilots who do not wish to go
truments can keep this in mind.
night, the rule is to avoid the
of heaviest lightning. In par-
vertical lightning and cloud
und lightning are the tip-off
rong vertical currents and pre-
ion process are present. They
e mechanism for producing the
rges. Research points to the
tion of ice as a hitherto un-
mechanism for developing the
. This refers to the ice-water
of precipitation. Actually on
craft, wing icing is not so com-
encountered, apparently be-
so much water is present that the slush ice is washed off during short traverses. But throughout cloud flight carburetor ice has to be expected, of course. The fact that a hail stage is going on in cumulonimbus clouds more commonly than reported at the ground is indicated by the fact that the soft slush just mentioned is frequently found to contain small pellets of hail. We are just lucky that the final hard hail stage is not as common but the hazard is always present in a thunderstorm.

Wherever you fly, cloud to cloud lightning is to be expected. It is nice to know that this is considered mainly psychologically upsetting, in case it bothers you. It is from a physiological standpoint that another rule is handed down. When you go through a thunderstorm, turn up all the cockpit lights. The reason is that if lightning strikes close to your windshield (it has an affinity for props and pitot heads) the flash will not blind you momentarily as it would otherwise. Dark glasses can be worn instead, and are particularly useful at low altitudes where windshield reflections and ground lights are confusing. The object is to be able to stay on instruments.

Lightning is useful in one respect, at least. It produces static crashes heard on all except UHF radios; if these increase in noise and frequency, the nearness to the storm source is evident. Nature provides another sort of warning that can be seen as well as heard. Continued rapid-fire cloud to ground lightning strikes have been observed to accompany tornado development.

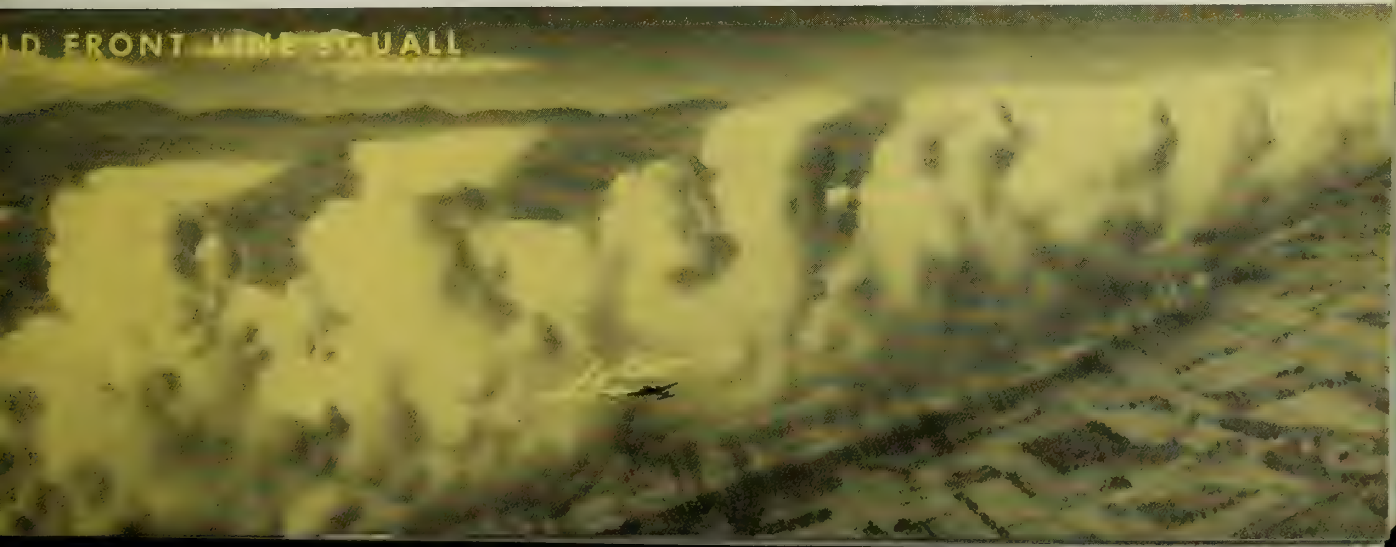
What is useful about *alignment of storm and terrain?* Well, to start with you have a single symmetrical thunderstorm, five to ten miles in diameter, like a typical overgrown cumulus. This is no problem. You can fly around it — circumnavigate is the word if you don't want a position report to read like you were going around in circles. Even then you would want to know which direction it was moving; as it would likely be softer on the rearside.

Actually the winds at the surface can blow out of the storm in all directions so they do not fix the direction the storm is moving. The winds aloft, if they are strong enough, will govern the direction of motion. The slope of the cloud and the character of the streamer out of the cloud point the direction of motion if they can be observed. Shelves of cloud often build out of the storm in several directions to obscure the view, however.

Even isolated storms have a tendency to become elliptical in shape. This is probably from the continued development of new cells as seen on the radar screen where these rain echoes often appear as blots that become elongated as the cells line up. As mentioned later, due to the movement of the air mass in one direction with the wind, there is a preferential system of cloud formation that leads to the arrangement of storms in a line. These so-called squall lines may be ten or a hundred miles long. The terrain plays an important part in the alignment that such storms take. This can be observed by the pilot when he becomes familiar with the topography and interprets it to his personal advantage.

Another factor influencing the development of such squall lines will hardly be obvious to the pilot. This is the convergence of the air which

**The smart pilot will stay clear of this typical line squall. As always in this cloud formation it comes equipped with the usual hazards of heavy turbulence, severe rain and continual lightning flashes.**



**Over the wing of this AWS weather recon plane is a big build-up of cumu-lonimbus heralding some rough flying weather to come. Weather Control will plot and track the storm from reports sent back by the recon flight.**

can only be determined from a study of the weather map. An airline uses this as one factor in computing the turbulence to be expected.

The point is that such elongated storms should logically be flown crosswise. This is the same technique as applied to crossing a front, which is often just more such clouds and lines on a larger scale. It pays to know the alignment of the weather, if for no other reason than if you deviate from course to avoid storms, it is not a random operation. Some clues to the alignment are given by the weather map and more by observation and knowledge of the effect of the local terrain. Hills and valleys, islands and streams are some of the features giving the so-called orographical effects.

Although not always noted on weather maps, a shore line can be a boundary marking a difference in up and down motions so that cloud boundaries often parallel coastlines. A storm moving off shore may lose its lift rapidly, and a different air mass moving on shore may start its vertical development there. This reversal depends on whether the air mass at the edge of the Gulf Stream are a classical example of such a pattern of instability. Obviously flight planning should take advantage of such natural boundaries.

### Turbulence

Another word about terrain applies to mountain regions. Glider pilots have long used upslope winds for soaring on the windward side of mountains and have learned to cross quickly the downdrafts on the lee side. So have mountain pilots. Unstable air develops the same pattern of vertical current distribution which is easiest to see in the standing wave clouds that form on various scales behind mountain barriers. Not recognizing this, it is going to be very discouraging to try to outclimb a downdraft of some thousand-feet-per-minute on the downstream side of a range. The axis of the draft will parallel the range and may continue for the length of the hills while being rather narrow crosswise. Its nearness to the peaks varies with conditions of stability, wind velocity, and elevation. The climb on the lee side has to be made in wide valleys where there is sufficient turning radius to sound out the drafts.

Updraft regions may be found on either side of the range and used to advantage. Pilots in western states find the air is often unstable and more turbulent over mountains than in the valleys where it is smoother because of less mechanical mixing. This can be anticipated from reports on the stability, the clouds and wind velocity aloft. The requirements for flying underneath in the mountains are enough ceiling, enough power and a knowledge of the terrain.

When on instruments and th weather gets rough, a good questio to ask is "which direction is cros wise and which is lengthwise, in a storm"? The standard recommenda tion is to continue on the same course otherwise milling around increases your turbulence time. However, whe flying through this type of weather if it has been really rough for as lon as 20 minutes, one is justified i changing course 90 degrees for se eral minutes and then trying th original course again.

Some pilots have evolved a pro ing technique as a result of careful observation and experience than i seems at first glance. They fly int the most promising (?) part of th storm after carefully picking thei altitude, then if the turbulence ge particularly severe or if they e counter hail or extreme precipitation the course is changed 120 degrees an held for two minutes, then the ori inal course is resumed. The intenti adar installation like this, AF measures storm heights obtains wheather data.

avoid the core of the storm, and ssumption is that encountering severe activity indicates the cen- f the storm is directly ahead.

e way they turn is influenced by ooks of things at that point. If guess right they will miss the r because as the measurements ll size indicate, such a maneuver go around one development. If is no good evidence on which to turn, there is no assurance they will not turn in to a core ad of away from it. Similarly, there are many cells in various s of development other active may be encountered. However, changes in course are practical ever hail is encountered, but that a 180-degree turn is not sarily the best course at that cular time.

word about turbulence. One can see from the typical cloud motions shown by the arrows in the cloud drawings that horizontal winds will be encountered. They have been referred to as nose gusts and tail gusts. You have felt them on the ground and know their strength. These horizontal motions are but part of the large scale eddies present within clouds, building up to velocities of say 30 MPH. When these varying velocities are encountered in a cloud traverse, the result is a rapidly changing lift on the wings that gives the turbulence its feel. The airspeed indicator tries to record the changes as shown by the resulting vibrating needle. However, it is the prolonged changes in the airspeed when a tailwind is encountered, that drops out the bottom.

The vertical motions started by the instability of the air due to condensation and evaporation processes start the turbulence of course. Drafts are the further development of the instability which can reach velocities of 100 feet per second.

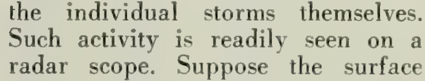
The pilots are often in an unique position to see these and their reports to the weather office furnish valuable information for analyzing the behavior for forecast use. Take a typical case from the weather map. It will be found that the thunderstorms will often develop in a line removed from any surface front. Some part of this alignment and its motion are due to the dynamics of the thunderstorm itself.

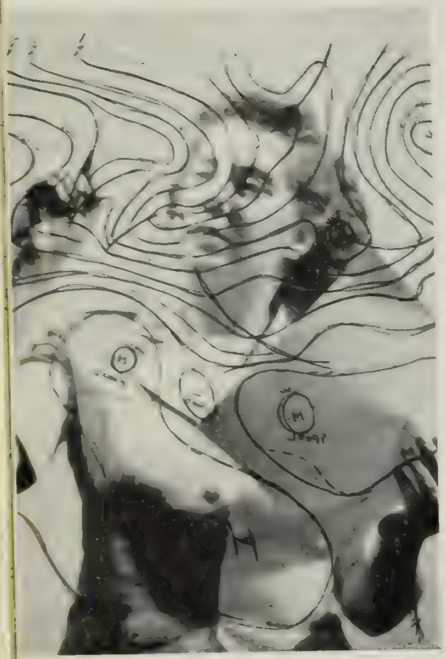
### Consider Squall

Consider the squall generating capacities of the thunderstorm. We know that thunderstorms move with the average winds in the moist layer. This wind aloft could change more than 30 degrees clockwise in direction from the surface wind in the warm air masses in which we have most of our thunderstorms. As mentioned, these original storms die out as they proceed. New developments form most readily on the small surface front coming out of the storm. This will usually be to the right of the old storms in the northern hemisphere. This gives rise to a translation of the line of thunderstorm activity to the right of the motion of the individual storms themselves. Such activity is readily seen on a radar scope. Suppose the surface wind is south, with upper air going into the west by the time the freezing level is reached.

### Storm Movements

The storms individually move to the east, often in a regular southwest northeast line. But these storm areas rain themselves out, as it were, and dissipate while new developments appear to the southeast. The squall line which is made up of continually renewed thunderstorms seems to move to the southeast, in a direction roughly from 90 to 180 degrees from the surface wind. When observing the kinematics of such a storm genesis, information on where the new storms are forming is the most wanted. The pilot can often furnish this to the forecaster. ●





Left, contour lines are labeled on a pressure map. Below, an Army tank stands guard for a mobile AWS team. Right, a storm detection radar in action.

# Tailor Mad

THIS is the age of the specialist. The man who drives the nail no longer strings the wire and installs the plumbing. As a species, the American handyman is virtually extinct. The jack-of-all trades has given way to the master of one.

The trend toward specialization has been particularly rapid in the Air Force where the need for master craftsmen has had to keep pace with technological advances so swift as to be almost incredible. These advances spelled, in two words, specialized missions for all elements of the Air Force, not the least of which was Air Weather Service.

From its earliest days as the Meteorological Section of the Army's Signal Corps, geography was the key to the operations of Air Weather Service. A squadron headquarters, with an area of responsibility determined by location, supervised AWS detachments. Until the advent of the Jet Age, A-Bomb and Cold War, the system served its purpose well. For even during the trying days of World War II weather service was generally standard for local training and for cross country flights within the United States.

But the days following War II brought new and more complex equipment — and a very real danger. Within a year of VJ Day, Strategic Air Command, Air Defense Command and Tactical Air Command — each with a distinctive mission — were born. Net effect was that all major commands of the Air Force were placed on a functional basis of organization. Individual bases and installations of the major commands were scattered throughout the country and in no instance were they lumped together geographically in any single location.

Meanwhile, Air Weather Service continued to operate its geographical system. But now cooperation between supervisors in AWS and operations people of the major commands became increasingly difficult. SAC bases, for example, were served by detachments assigned to nine different weather squadrons, each of which provided service to units of four major commands. For the most part, headquarters of these commands were located outside of the weather squadron's area of responsibility.

There was inadequate liaison between the weather unit and using organization; hence, the weather squadron was not intimately aware of the command's operational requirements, nor could it take decisive action to remedy support deficiencies. Strategic Air Command missions were largely of the high-altitude, long-range type. Tactical Air Command, in contrast, needed special service for missions of short duration flown at low levels.

While it is true that weather observations, surface and upper air analyses and the preparation of forecasts are common to all weath
tions, the application of this da
fers among the commands.

Maj. Gen. W. O. Senter, Com
ing General of Air Weather S
called attention to the differenc
than two years ago in a letter
Gen. Laurence S. Kuter, then
MATS.

### Strategic Forecasting

"Strategic forecasting," C
Senter wrote, "requires a hemis
concept of weather conditio
the ability to provide foreca
ering great distances, high a
and long periods of time. T
forecasting, on the other hand,
erally limited to a much shor
tance, smaller area and the tim

elow, on a weather recon flight, a
rewmember stands by to release a
ropsonde; right, at an airbase in Ko-
ea, an officer tracks a rawinsonde.

# eather

al is much less. The weather fore-
asting problems incident to tactical
nd strategic operations are as differ-
nt as the concept of the operation of
ne two forces. Weather requirements
or the Training Command differ
rom both tactical and strategic
perations."

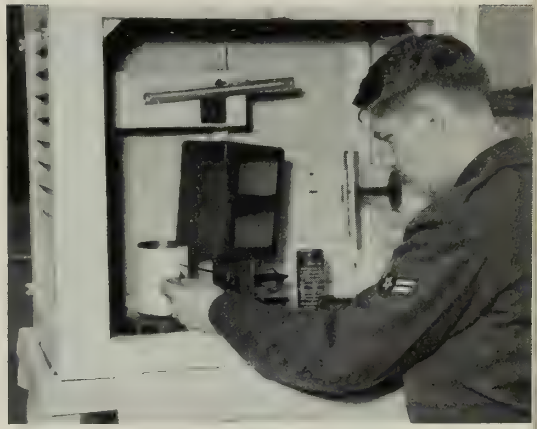
Weather Service had people who
new a little about all of the aircraft
ir Force was using and about as
nuch of each command's mission.
he critical personnel shortage which
ollowed post-war demobilization
nade necessary assignment of inex-
erienced officers and airmen to AWS
nits. Few were equipped profes-
ionally to provide specific data on
articular aircraft and particular
nissions. Yet mission requirement
had come to be the most important consideration in the technique of forecasting. AWS studied its organizational structure closely and concluded that no matter how greatly it was strengthened, it still could not give major commands the specialized support they required.

The solution to the difficulty lay in abandoning the old geographic system and substituting for it a functional organization in which Air Weather Service command channels would parallel those of the Air Force. The decision to do just this was made and the changeover was planned in exhaustive detail. When the reorganization had been completed, the historical study of Air Weather Service termed it:

"A major event in the history of Air Weather Service since it enabled the organization, for the first time, to give using agencies in the Zone of Interior a specialized meteorological service specifically tailored to their individual needs."

In its present format, AWS has assigned a group to each command in the United States. Each group has the number of squadrons and detachments it needs to serve the Air Forces and bases of each command. The weather group command is located in the headquarters of each command. Squadrons are located at the numbered Air Force level and detachments at the bases.

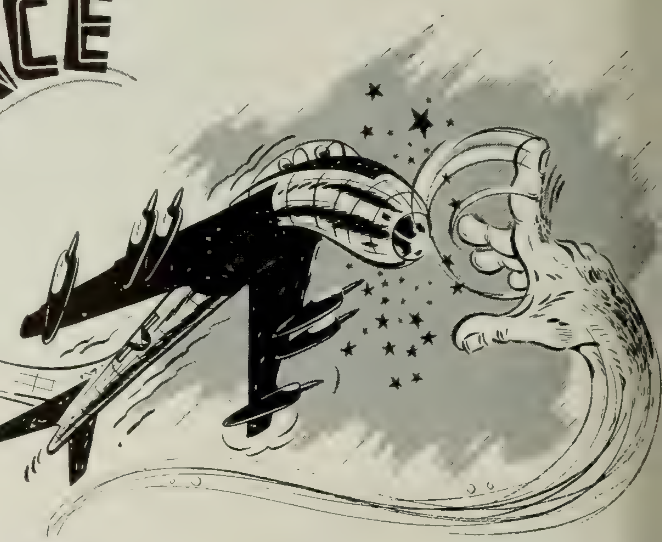
One of the simpler but important Air Weather operations are the reports that are taken at many small outposts.



As a result, the commander of each weather unit, in descending order of command, can act as staff weather officer for the adjacent major command unit. In a staff position, the weather officer thus has access to all mission planning. He knows what specialized data the command requires to satisfy its mission; and he has clearly defined command channels within his own organization to direct that the required information be provided. The groups are empowered to provide effective weather service to all levels of the major command, to act directly to eliminate operational shortcomings, to guide weather detachments in meeting specific operational requirements and to concentrate their efforts toward solving particular command weather problems.

Nor does this functional design jeopardize the global system concept that always has been associated with Air Weather Service. Indeed, it furthers that concept because it makes AWS capable of shaping its information to the specific needs of the major commands. The world-wide weather network remains under Air Weather Service Headquarters for technical control and personnel assignments. Weather reconnaissance squadrons, which track Atlantic hurricanes and Pacific typhoons and make regular observations in the Arctic, continue to gather information of use by all military and civilian weather facilities. ●

# CLEAR AIR TURBULENCE



### Next time you get jolts out of the blue Make a report to the weatherman.

**By Lt. Col. William H. Wyatt.**
**USAF Air Weather Service**

HAVE you ever been flying along in perfectly clear air, with not a cloud for miles around, when suddenly your plane was bounced and jarred as if you were driving down a corrugated road? If so, you have experienced clear-air turbulence and can understand why this unpredictable gustiness is becoming an important problem. I'd like to describe my recent trip in the Air Force's six-jet bomber—the B-47—and tell just how it feels to be shaken up with no apparent reason.

It all began when I was briefing B-47 pilots at Wichita Municipal Airport on the nation-wide program of the National Advisory Committee for Aeronautics for collecting reports of all high-level clear-air turbulence encounters. We took off from Wichita, climbed to approximately 30,000 feet, then leveled off and headed for Oklahoma City and Fort Worth.

The weather was perfect — clear, with good visibility — and the trip to Fort Worth was smooth and uneventful. I had time to look around the plane and marvel at some of the changes that had taken place since the days of the B-17. Having been accustomed to feeling and hearing the rhythmic throb of piston engines driving the propellors, the smooth power of the jets was a new experience to me. We saw our first clouds while passing over Fort Worth, a thin cirrus that looked to be at about 40,000 feet. We turned and headed back for Wichita, now at 37,000 feet indicated altitude. The sky again cleared.

Just after passing Oklahoma City, I felt a series of short, choppy bumps hit the plane. There was an interval of about one second between bumps, giving the sensation of riding in a motor boat across the wake of another boat on a smooth lake. The pilot said the wingtips would flex through an arc of about two feet under these conditions; the plane itself did not seem to move up or down with the gusts. We climbed to 40,000 feet and, as suddenly as it had started, the turbulence disappeared. After about a minute of flight at this altitude, we again descended to 38,000 feet. The bumpiness was again evident during this descent, although it soon ceased and we flew the remainder of the trip back to Wichita in smooth air.

The weather situation at the time of this clear-air turbulence encounter is interesting. Figure 1 shows the location of this turbulent area on the flight cross-section; Figure 2 indicates its relation to the lapse rate and the tropopause. As seen from the Oklahoma City sounding (Fig. 2), the bumpiness occurred just below the tropopause and ended as the plane approached the stratosphere. The main jet stream at this level was far to the north — across southern Nebraska. There was, however, at a lower altitude (30,000-35,000 feet), another jet stream just north of t
turbulent area, between Oklahor
City and Wichita.

Much more information of th
type is needed to solve the problem
of what causes clear-air turbulen
and how it can be forecast. At pr
ent some rules-of-thumb have be
developed. For example, the occ
rence of these gusts is associated w
the tropopause or with the jet strea
and it has generally been found th
a climb or descent will end t
bumpiness and put the plane back
smooth air again. Since the loads a
stresses that this unexpected form
turbulence can impose must be c
sidered in aircraft design, the imp
tance of this unseen hazard is v
evident.

Before World War II, pilots a
weathermen associated turbulent
(bumps and jolts in flight) with
mulus clouds, wind blowing o
rough terrain and convective c
rents sun-heated surfaces. During
second World War, however, repo
began to come back that pilots w
meeting turbulence in clear air at
altitudes and at distances far
moved from any type of clouds.

As new designs raised aircraft fli
ceilings and speeds, the frequency
such reports increased. Clear air t
bulence has now been recognized
a major problem confronting pil
weathermen and aeronautical en
neers. The solution to the probl

in wholehearted cooperation
ng the three groups concerned
the turbulence.

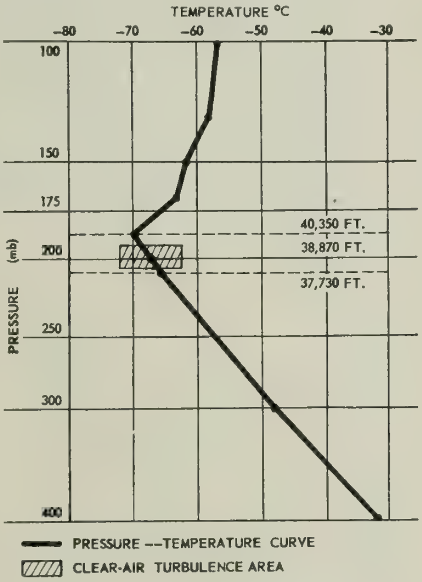
irst to recognize and study the
blem, the British organized a re-
ch project in 1947 to investigate
r air turbulence and came up with
e very significant findings. For
mple, the British study shows that
r air turbulence occurs in iso-
d patches and at varying alti-
es and is of variable depth, length
width.

eports indicate that the average
ple of clear air turbulence is 50
100 miles long and only about
0 feet thick. Unlike thunder-
m turbulence, clear air turbu-
e seldom results in a change in
plane's altitude, as is the case
n a plane flies through strong
ical currents (updrafts and down-
fts). There is little pitching or
ing and the bumps follow one
ther faster than in convective
ds, giving the feeling, as one
t put it, of "being in a fast car
suddenly running over a series
leep, unseen ruts in the road."

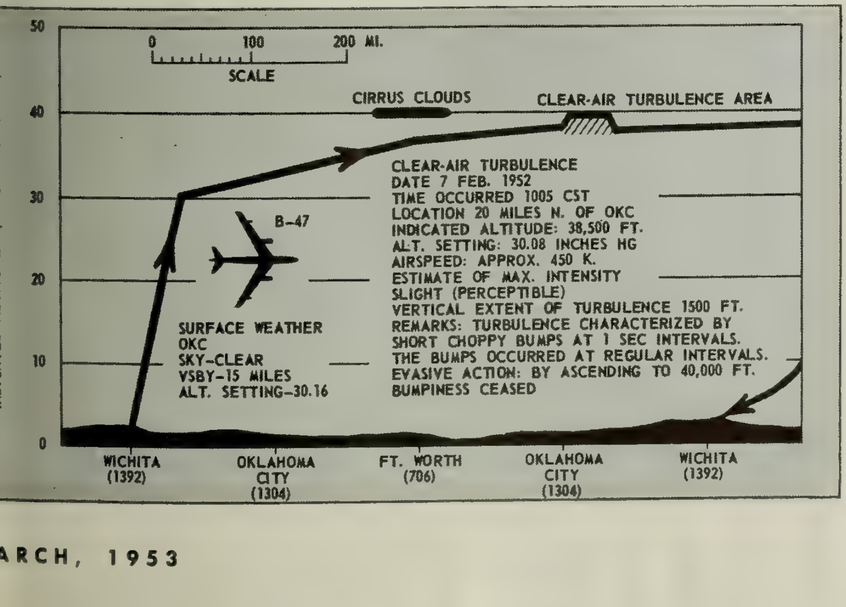
ritish analysis of the possible
ses of clear air turbulence indi-
s that it is associated with a
ked increase or decrease in the
ical wind velocity and that the
st turbulence is associated with
streams, which are wandering
rs of fast-flowing air at high alti-
es. Clear air turbulence appears to
ur often near the tropopause, the
er of air at altitudes varying from
to eleven miles above the earth at which the lower atmosphere becomes the stratosphere.

Since the British beginnings five years ago, joint efforts of the National Advisory Committee for Aeronautics, the United States Air Force, the U. S. Navy, the U. S. Weather Bureau and the civil airlines have launched a clear air turbulence program in the United States. Some 400 reports have been received and analyzed under this program, providing valuable information on the subject.

Sufficient data has been collected to give design engineers a basis for computing stress on aircraft structure caused by clear air turbulence. The program has not, however, provided adequate data for comparing clear air turbulence with other weather conditions for the purpose of forecasting the turbulence. Value of the program to pilots has so far confined itself to the long-range benefits they receive from aircraft designed to withstand clear air turbulence more adequately.



**curve in Fig. 2 (above) shows the relation of barometric pressure to
perature in degrees Centigrade for Oklahoma City, February 5, 1952,
0900 CST. The clear air turbulence area is close to the height of lowest
perature. Below (Fig. 1) is the round trip cross-section of the flight.**


50
40
30
20
10
0
0
100
200 MI.
SCALE
CIRRUS CLOUDS
CLEAR-AIR TURBULENCE AREA
B-47
CLEAR-AIR TURBULENCE
DATE 7 FEB. 1952
TIME OCCURRED 1005 CST
LOCATION 20 MILES N. OF OKC
INDICATED ALTITUDE: 38,500 FT.
ALT. SETTING: 30.08 INCHES HG
AIRSPEED: APPROX. 450 K.
ESTIMATE OF MAX. INTENSITY
SLIGHT (PERCEPTIBLE)
VERTICAL EXTENT OF TURBULENCE 1500 FT.
REMARKS: TURBULENCE CHARACTERIZED BY
SHORT CHOPPY BUMPS AT 1 SEC INTERVALS.
THE BUMPS OCCURRED AT REGULAR INTERVALS.
EVASIVE ACTION: BY ASCENDING TO 40,000 FT.
BUMPINESS CEASED
SURFACE WEATHER
OKC
SKY-CLEAR
VSBY-15 MILES
ALT. SETTING-30.16
WICHITA (1392)
OKLAHOMA CITY (1304)
FT. WORTH (706)
OKLAHOMA CITY (1304)
WICHITA (1392)

It is here that pilots may help themselves by helping the weatherman. Pilot reports received under the present program have been scattered and submitted only when clear air turbulence was encountered. Reports have been taken from all altitudes over a long period of time, making them largely inadequate for accurate analysis from the forecasting standpoint. Under the present program, lack of a report in any particular area may indicate either no clear air turbulence or no aircraft operating in the area.

What is needed is a program to provide for a short-term concentrated effort on the part of pilots to collect data by submitting reports of the occurrence or non-occurrence of clear air turbulence at specific altitudes.

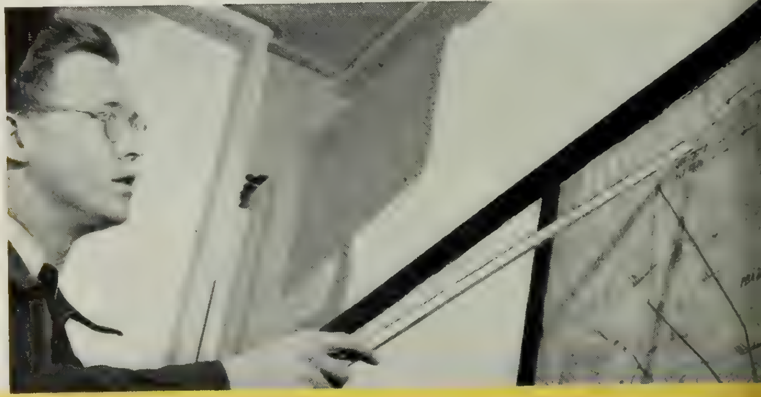
With the assistance of as many as possible of the military and civilian pilots in the United States, such a program has been established this year by the U. S. Air Coordinating Committee. The new program calls for an all-out effort to collect data specifically at 30,000 and 39,000 feet altitudes at specific times during a three-day period sometime during this month.

Units of the USAF, the Navy and the various civil airlines with aircraft capable of reaching these altitudes are being asked to have as many planes as possible participate in the program. Wherever it can be done without adversely affecting normal operations, pilots will report on forms similar to postcards both the occurrence and non-occurrence of clear air turbulence. Pilot report cards will be distributed by AWS forecasters at the base weather stations, who will also brief pilots on the procedures to be followed and the type of data desired.

A successful reporting program may go a long way toward taking the mystery out of clear air turbulence, and its success depends upon the wholehearted efforts of all participating pilots. ●

# Jet STREAM

*When in a hurry take advantage of a jet stream — but you had better be sure it's going your way.*



**Much of the information used by weather stations for winds aloft brie
over water flights is compiled by weather recon crews who report jet st**

JET streams are narrow currents of very strong winds which meander between 20° and 70° latitude and flow in an easterly direction. They are usually found from 20,000 to 40,000 feet above sea level. This is the region which became important as a flying level during World War II when the first high-altitude bombing missions were flown. With the advent of jet aircraft, it has become a well traveled air lane for military planes, and commercial airlines are now considering this level for regularly scheduled passenger flights since jet engines thrive on thin air.

### Jet Stream Discovery

The strong winds were christened "jet streams" by the weather experts at the University of Chicago early in 1947. Jet streams have nothing in common with jet aircraft. The name was chosen because of the similarity that exists between jet streams in the upper atmosphere and those already studied for many years in hydraulics. Some authors have also pointed out the similarity of jet streams to strong ocean currents, such as the Gulf Stream.

As has been the case with many important scientific findings, the facts of the case were known in bits and parts by many students of the upper atmosphere for a long time. It remained for the Chicago group to organize the facts, give them a suitable name, and present a theory to explain what others had observed. The most famous cases of jet stream winds, before they were named, were encountered during wartime bombing missions over Tokyo and Berlin.

USAF bomber crews sometimes reported that they encountered such strong headwinds over Japan that in flying inland from the ocean, ground speed was reduced to practically zero; but when heading back out to sea, ground speed was nearly double the indicated airspeed. We know now that jet streams of strong velocities are common over Japan at the levels and seasons at which the first B-29 raids were flown.

The RAF encountered a similar situation during the famous Berlin raid of 24-25 March 1944. The group of bombers was caught in a violent wind and carried far south of the target. One aircraft found itself c
Leipzig and had to fly north to
lin. Its bombs were dropped half
hour late. Another plane, wh
missed Berlin completely, was fly
over Paris on the way home whe
should have been over southern
land. After the war a study of
man upper air charts showed a
nite jet stream over Berlin at the
of the raid.

Jet streams must be taken serio
in planning long-distance flights
an air crew is on a bombing miss
it doesn't want to be slowed dow
less than 100 miles an hour over
target. An airline company can't
ford to have its scheduled flight
tween New York and San Franci
for example, delayed for sev
hours because of an unexpected
mph headwind over Omaha. A
or navigator planning a long
tance, high level flight must
advantage of the strong winds of
jet stream to shorten the actual f
time. If a jet stream is identified
course while in flight, it is wis
deviate from the normal great c
course and join the jet stream
pick up a tail wind. If a jet strea

st tools for locating jet stream
the 200-300 millibar charts.

countered on-course as a headwind,
would be perhaps best to deviate
m course to fly in an area of
aker winds.

The only trouble with all this plan-
g is that it's a lot easier to say
erwards that you were in a jet
eam than it is to predict the place
ere the strong winds will be. In
last four years a great deal has
en learned about jet streams, but
fact remains that wind data at
h levels is still very sparse. Since
jet stream is a very narrow cur-
t (when measured transversely
m half max speed on one side to
lf max speed on the other) and
ce observations are reported rela-
ely far apart, the weather officer
s a hard time pinpointing the jet
eam on his weather chart.

Narrowness of the current and high
eed of the winds are two major
aracteristics of the jet stream. The
ximum speed is generally found
ar the 250 millibar surface (ap-
oximately 35,000 feet above sea
vel), although streams have been
ported at all levels from 15,000 feet
to 50,000 feet. The maximum
eed is well in excess of 100 mph
winter and speeds of 200 mph are not unheard of. Jet streams are believed to be a key part of the prevailing westerlies. Consequently, they are not found in the northern hemisphere north of the 70th parallel or much south of the 20th.

There may be one jet stream indicated on a northern hemisphere weather map or there may be several. They are sometimes continuous with an axis which appears to circle the globe. Although theoretically the axis of the jet can be drawn around the world, the stream widens and weakens to such an extent that it really can no longer be considered a jet in certain portions. It is more appropriately considered a broad band of westerly winds. More often, jet streams break up and move around the earth in large waves. Thus, although the jet stream occurs in the westerlies, it cannot always be relied upon to furnish a strong westerly current at the required time and place.

A jet stream may take weeks to complete its cycle or it may disappear in a few days. The high winds originate between 60° and 70° N., but in summer the source may be farther north than in winter. They then drift southward in mean latitude with an average speed of one-half to two degrees per day and reach their maximum strength at about 50° N. in summer and 40° N. in winter. The actual movement is difficult to determine because the jets separate like an ocean current into smaller streams or fan out and get lost in the local circulation. One branch may shoot north while another branch goes south and as a jet stream deviates from straight zonal flow, it passes south of cold lows and north of warm highs. A jet stream also can change altitude as it moves. Jets are usually found at higher levels in the south than they are in the north. Usually two jet streams are identifiable at the same time, but there may be only one clearly defined current when an old jet is dying.

The experts say that the best tools for locating the jet stream are the 300 and 200 millibar weather charts which show a packing of contour lines and strong winds reaching their maximum in the core of the jet stream. If these very high level charts are not available, jet streams can sometimes be found by locating a region of rapid temperature change across the wind flow on the 500 millibar chart. The jet stream core often occurs 10,000 to 15,000 feet above this packing of isotherms.

### Effect on Tropopause

In the vicinity of the jet stream the tropopause is usually broken. The tropopause over the cold air is several thousand feet lower than that over the warm air. In individual cases, the tropopause over the cold air appears fairly level while that over the warm air is sloping. The strongest winds occur in the warm air above and to the north of the surface position of the front and almost directly over the main polar front at 500 millibars.

The winds build up slowly across the peripheral regions to reach a maximum at the center of the jet stream. Where the lines of equal wind speed (isotachs) are close together, the rate of change of wind speed, generally called wind shear, is much stronger. The wind shear is fairly severe on both sides of the jet. In extreme cases a decrease in wind speed of 100 knots in 100 miles has been reported north of the jet stream and 100 knots in 300 miles on the south side. Vertically the isotachs are relatively close together. A decrease of 100 knots in 12,000 feet above or below the center of the jet is by no means uncommon.

Light to moderate clear air turbulence has been found in the jet stream in the vicinity of the tropopause. Severe clear air turbulence has also been encountered there on rare occasions. Clear air turbulence occurs in small unpredictable patches, hence it is unlike the sustained roughness felt when flying in convective clouds or at low levels.

At present, USAF experts on the jet stream are looking forward to the time when they will be able to analyze the jet stream directly. An analysis of the jet stream is now a time consuming task which requires the construction of pressure-contour charts using extrapolated data where soundings do not reach high enough. New equipment recently put into operation at some Air Force bases provides reliable wind data to higher levels than previously. If and when this equipment or a similar type comes into general use throughout the world, not only the jet stream, but the entire wind field will be much more clearly defined. ●

# STORM WARNING CENTER

**Above: Weather officers are busy p paring surface climatic changes northern hemisphere charts every hours. The weather condition of f different altitudes is charted da**

### By Lt. Col. E. J. Fawbush, Severe Weather Warning Center, AWS

IN its current operational status the Air Weather Service's "Severe Weather Warning Center" is charged with the responsibility of issuing forecasts of the weather phenomenon, accompanying the thunderstorm, which presents a hazard to aircraft in flight or to military ground installations within the zone of the interior. These phenomenon are the tornado, damaging straight live winds, hail at the surface and aloft, and severe turbulence aloft. Forecasts are issued as required in abbreviated plain language and are disseminated over the USAF weather teletype network. The Severe Weather Warning Center is staffed by four forecasters and eleven observers.

The envolvement of the Severe Weather Warning Center into a specialized forecasting unit in its present form covers a period of four and one-half years, that had its inception in March, 1948. During that month, two particularly damaging tornadoes struck Tinker AFB, Oklahoma City, Oklahoma, within a span of five days causing several millions of dollars damage. After the first tornado hit the base on the 20th of March, we began to correlate the surface and upper air synoptic patterns in existence prior to the Tinker storm and in several other past tornadic occurren Working in conjunction with Ma Robert C. Miller, we noted cert similarities in these synoptic patte and evolved a simple set of r which we felt might be a step tow the possible forecasting of tornad

On the morning of the 25th March, 1948, we were confro with a set of surface and upper charts which contained, in pre inary form, all the synoptic in dients necessary to tornadic deve ment. Using the rules we had set we came to the decision that Tinker AFB area itself was again most critical area for a possible se

**rmation received from military ther stations all over the world g charted and prepared for relay.**

ther occurrence. A base storm ning was issued for excessive ds and all precautions were taken ase officials.

became increasingly apparent to hat, according to our empirical s, tornadic development in the ral Oklahoma area was very y. At 1810 Central Standard Time he 25th of March the second tor- o in five days formed southwest he base and passed through the moving northeastward.

ith this apparent confirmation of beliefs, we made several more tical forecasts during the year in ahoma and Texas with good suc- .

1949, in addition to our regular ther station duties, utilizing our cast procedure we made fourteen ado forecasts for the Kansas- as-Oklahoma area and in all but instance tornadoes occurred with- he forecast area. These forecasts not disseminated over the tele- during this period but were n to the weather bureau office in Oklahoma City for informational purposes. In 1950 the forecast area was enlarged somewhat to include most of the middle west and the gulf coastal states. During this year thirty-three tornado forecasts were issued of which twenty-nine verified. In August of 1950 arrangements were completed whereby these tornado forecasts and also forecasts of high winds and hail, accompanying thunderstorms, would be transmitted via USAF teletype to the Global Weather Central of the Air Weather Service at Omaha, Nebraska. During the remainder of 1950, one hundred nineteen severe weather forecasts were issued in this manner and one hundred fourteen of these forecasts verified.

During the early months of 1951, the Air Weather Service decided to relieve Major Miller and me of the routine weather station responsibilities and set up the Severe Weather Central in its present form. The area of responsibility was increased to include the entire zone of the interior on a 24-hour basis. All severe weather phenomenon accompanying thunderstorms were to be forecast as accurately as possible and disseminated to all Air Force weather installations via teletype. During this year from February to December the Severe Weather Central issued eight hundred sixty forecasts of high winds and/or hail and eighty seven tornado forecasts. Of these forecasts eight hundred forty three wind and hail forecasts and seventy eight of the tornado forecasts were verified.

During the four and one-half years, of course, considerable refinement of the original empirical rules has taken place, although basically the procedure remains about the same. The production of severe weather has, as its first requirement, potential instability of the air mass. In other words, the vertical structure of the air must be such that a disturbance of the air column, like a front or heating, will cause violent overturning of the column. This overturning then produces thunderstorms and violent weather. As has been pointed out by meteorologists over a period of years the air structure most favorable for tornadoes requires a concentration of moisture in the lower levels of the atmosphere, capped at intermediate levels by a temepratue inversion or "lid" above which conditionally unstable dry air exists. This type of vertical air structure is especially required for tornadic development and also is productive of violent straight live winds and hail. The cap or temperature inversion, however, is not necessary in the production of violent straight live winds, although the dryer air aloft is desirable.

With the basic requirement of potential instability satisfied, we must then subject this portion of the air mass to forced lifting or triggering. This can be accomplished by an intrusion of a front into the air mass, formation of a squall line, an upper front or, in the case of strong straight live winds and hail, simple convection. If this triggering action is, or will become available, during the forecast period in the instability area, violent weather will result in the area of greatest instability. To further isolate this area, an effort is made to locate the axis of strongest wind flow aloft at elevations from 10,000 to 20,000 feet MSL. It has been found that the maximum intensity of thunderstorm weather phenomenon will occur along either side of these maximum wind surges. This is a particular requirement for tornadic development and in most cases, with other factors being equal, the difference between the production of tornadoes as against straight live winds.

In the absence of this "jet" flow aloft, isolation of the most severe activity is more difficult and recourse must be made to such local influences as terrain and strong surface winds.

A continuing research program is in progress at the Severe Weather Central, and concurrently, past data for numerous cases is being systematically gathered and logged. Upper air soundings taken near the time and place of severe hailstorms, windstorms and tornadoes have been collected over a period of two years and will aid in further refinement of severe weather forecast techniques. The goals of the Severe Weather Center are to continue issuance of accurate and useful severe weather forecasts and to refine techniques resulting in as much isolation as possible by severe weather areas. ●

USAF

# SE . . . . . WEATHERWISE!

**y Lt. Col. Harold L. Powell, Facilities Branch, D/FSR**

HE aeronautical age has disclosed three things you can say about weather, with or without the use profanity:

- It comes and it goes.
- It will continue to come and go.
- People will continue to talk about its coming and going.

n addition, studies—and statistics how that pilots have come out sec- d best in frequent tussles with the ments. As a matter of fact, a re- t study, conducted by the Directo- e of Flight Safety Research, shows t over a five year period close to eral thousand accidents have oc- rred, in which weather was a fac- .

n the majority of these accidents, ot error was considered the pri- ry cause factor. Close to 20 per t of the accidents were attributed other crew members, ground con- l and supervisory personnel, ma- iel failure, and weather phenomena hail, turbulence, and lightning. *The atherman himself was the primary use in only one-half of one per cent.*

All in all, the total impact on the r Force from these losses, dollar- se and personnel-wise, was consid- ble. What makes these losses so rd to take is that many of the acci- nts hinged on such simple causes reading an altimeter too high, try- g to maintain VFR during bad ather over unfamiliar terrain, tak- g a chance on landing at intended stination when weather dictated use an alternate, and failing to out- neuver gusts and cross-winds.

The accidents were segregated by ase of operation: Runup and Taxi, keoff, In Flight, and Landing.

It was found, not unexpectedly, at most of the accidents occurred ring landing. An analysis of the nding accidents produced the fol- wing facts:

- Surface wind was the weather ement involved in a major portion 7%) of the landing accidents. oss-winds were predominant, while sts figured prominently in about lf of the accidents attributed to nds.
- Pilot error was the primary cause factor in more than 90 per cent of the landing accidents. Most of the pilot errors involved manipulation of the aircraft. One major item in this category was loss of directional control of the aircraft after touchdown in crosswinds and gusts.
- Ceiling and visibility were above VFR minimums in more than 900 of the landing accidents.
- Weather personnel were charged with discrepancies in four per cent of the accidents. Most of these discrepancies concerned ceiling and visibility forecasts.
- Experience level was not necessarily a major factor, in that more than 80 per cent of the pilots had more than 300 hours of total flying time; and 65 per cent had more than five hours of actual "weather" instrument time.

The weather element second to wind in frequency of contributing to the causes of landing accidents was cloud condition.

It generally was the contributing factor in accidents involving instrument letdowns, which, from the standpoint of fatalities per accident, is one of the most deadly accident types. The main cause factors in this category were lack of adequate pilot instrument proficiency, poor pilot judgment, and insufficient ground control personnel proficiency.

### In-Flight Accidents

A goodly percentage of the weather factor accidents occurred while aircraft were between departure point and destination. An analysis of these accidents showed the following facts:

- More than one-half of the in-flight accidents were attributed to pilot error; errors of other crew members or supervisory personnel were major factors in 10 per cent; weather phenomena, such as turbulence, lightning and hail were responsible for 30 per cent, and materiel failure was a factor in five per cent.
- The major weather elements contributing to the accidents were, in the order of frequency, clouds, turbulence, hail, thunderstorms and rain.
- The major pilot errors concerned preflight preparation, which

**High-speed teletype machines keep Fifth Air Force combat wings and other FEAF flying organizations abreast of latest weather.**

covers a multitude of sins—failure to check equipment, weather, adequately plan route, fuel, terrain, and alternates—all errors of omissions. Navigation techniques, instrument proficiency, and voluntarily flying into thunderstorm areas also fell into this category.

- Weather personnel were charged with discrepancies in seven per cent of the in-flight accidents. Most of these errors concerned VFR ceiling and visibility forecasts when actual weather encountered was below VFR minimums.
- Seventy per cent of the pilots had more than 1,000 hours total flying time, and 78 per cent had more than five hours of actual "weather" instrument time.

It was noted that many pilots, after becoming airborne, apparently neglected to keep current on the weather, and especially weather forecasts for points ahead of their position. This neglect often forced them to make hasty, unsound decisions after they were on top of their destination, or plunged them into unexpected, hazardous weather at other points along the flight path.

As for weather personnel, apart from forecasting errors, it is apparent that some weather briefers haven't learned that being too precise about some weather values, (cloud tops, for example) can often do more harm than good. Exactness beyond the capabilities of forecasting methods can promote poor flight planning on the part of the pilot.

### Taxiing and Takeoffs

Taxi accidents in which weather was a factor numbered 195, with 179 of those involving wind. The remainder had factors of snow and rain reducing visibility, and snow and ice on taxiways and runways.

In reviewing accidents where weather was a prime factor, wind was considered the prominent weather element, contributing in about 51 per cent of the cases. Rain, fog, other obstructions to visibility, and snow, in that order, were blamed for the remainder of the accidents.

The primary cause factors in these accidents concerned pilot control of the aircraft just before and just after becoming airborne, resulting in groundloops, collisions with other objects, and crashes into the ground.

Not to be taken lightly, regardless of its speed, is the weather element of surface wind. It contributed to 53 per cent of the total number of weather accidents. In all but a few cases, the wind that gave trouble w either a crosswind, gust, or both, a was more than 10 knots.

This points to the necessity of pilot always checking surface win thoroughly for every flight, even f local ones, and getting the foreca er's idea of what is expected at ET Cooperation between the weather s tion, control tower and pilot is t big "MUST."

The weatherman can always he by providing all the information has on surface winds, not only f takeoff, but for every point at whi the aircraft plans to land.

As far as weather in general is co cerned, the pilot's considerati should not be hurried. The weath forecaster's middle name is serv and he will discuss as capably as can every weather element along t intended route. The pilot should ways take advantage of this.

Even for flights during which V weather is expected all the way, t pilot should play it safe by having alternate planned in accordance w fuel requirements. Then, if an I flight plan becomes necessary, it c be approached with a greater fund knowledge.

Finally, constant weather vigila by pilots in the air is necessary cause of the limitations of weat forecasting methods. These metho as every sincere weather forecas will admit, do not always give the curacy desired. For this reason wea er forecasters get their share of cr cism. On the other hand, it would wise for pilots to become acquain with these limitations, in order t safe allowances can be made dur pre-flight planning. In the same v it behooves the weather forecaster be frank with the pilot as to the curacy limitations of forecasting, that the pilot may fully consider personal capabilities and the capal ties of his aircraft and equipment.

It's a let-down-the-hair affair both sides, but there'll always problems and limitations. There'll days when a jet jockey can't get o that hump of cumulus at 45,0 when tops were forecast at 30,0 Those are the days when pilots ye for the revenge of seeing the wea erman drown in mercury from own barometer.

But—go easy, boys, the reco show that generally, the weather is a reliable ingredient of flight p ning. ●

In getting winds aloft data, ballons are tracked by radar.

### this is

# FLYING SAFETY

*The Office of The Inspector General at Norton AFB, Calif., is an organization that has been born of time, place and teamwork. Of missions assigned, one of the more important has been the formation of an effective flight safety research program with the concept of maximum aircraft accident prevention in the United States Air Force.*

*Through an aggressive approach to the accident problem, The Inspector General has already done much to bring about one of the lowest accident rates in USAF history. The accident facts and flying lessons uncovered today by highly-trained flight safety research teams are turned into knowledge which may be used to eliminate the accident of tomorrow. . . .*

**VICTOR E. BERTRANDIAS**
**Major General, U. S. Air Force**
**Deputy Inspector General**

### By 1st Lt. Wm. A. Johnston, Directorate Flight Safety Research

*The Directorate of Flight Safety Research, Office of The Inspector General, USAF, is charged with the responsibility of achieving maximum accident prevention. Through the application of scientific, investigative, educational, operational and engineering techniques, conservation of personnel and aircraft is possible. These techniques are applied in the correction of design and maintenance deficiencies in materiel, the critical evaluation of Air Force systems and procedures, and the proper selection and education of personnel. These problems are approached through the development of research into engineering, accident investigative and analysis techniques, the psychological and physiological research into human factors involved in accidents, the analysis of aircraft accident histories, and a close observation of all Air Force operations.*

*The Directorate, therefore, is composed of many segments, subdivided into crews of specialists whose main job is accident prevention and analysis. When a crash occurs, some important questions arise: What happened? Why did it happen? What can be done to keep it from happening again? Here's how it works.*

A C-47 crashed into a mountain while en route from Roger AFB to Wilco AFB. The crash site was 30 miles off course. There are fatalities, but rescue personnel report that there are some survivors. Wilco sends a report to the Directorate of Flight Safety Research, and the staff duty officer receives the TWX around 2300.

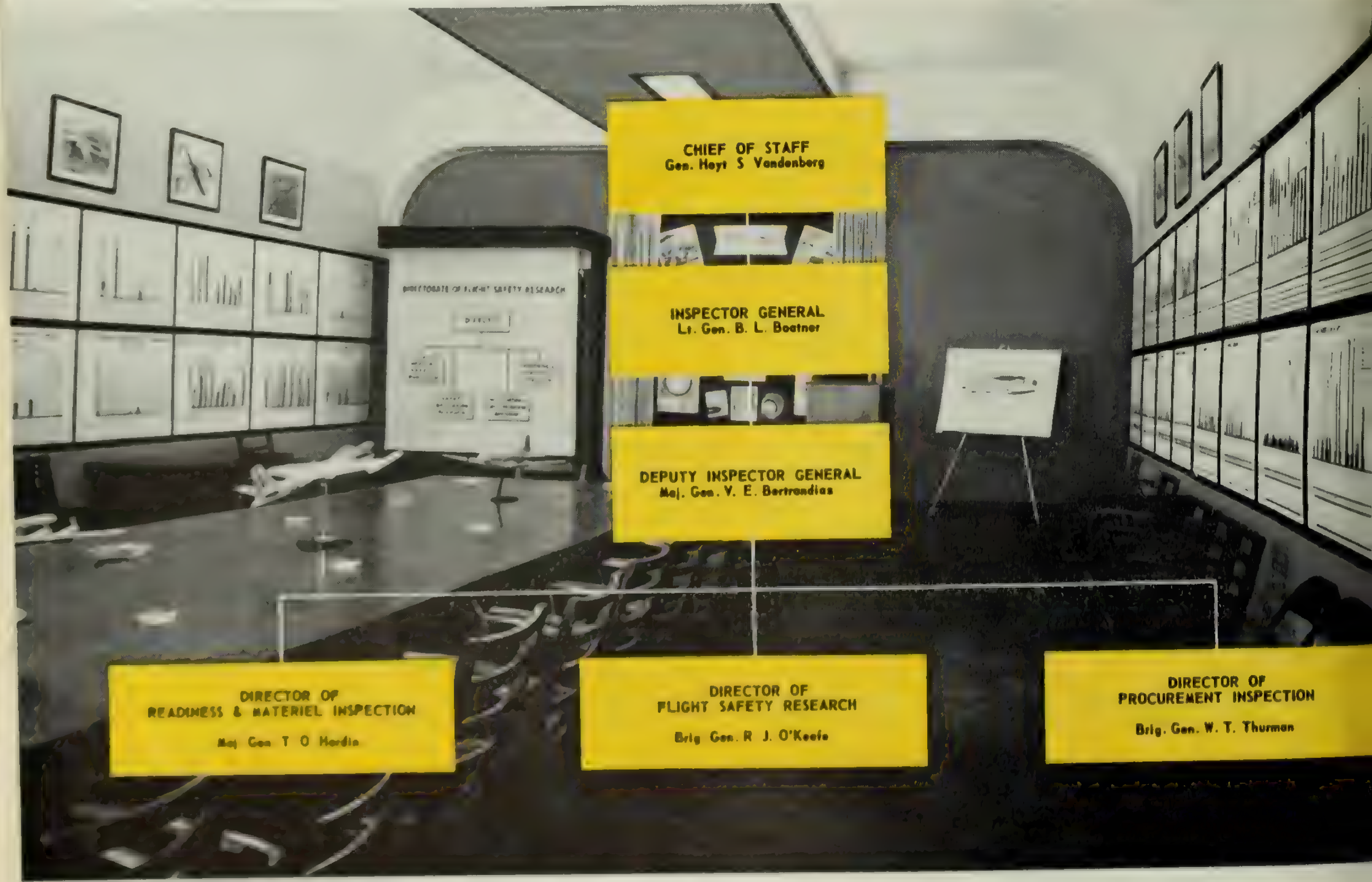
Immediately, all interested personnel are notified by telephone, and preparations are begun for the daily staff meeting which takes place in the office of the Director of Flight Safety Research at 0900. Various divisions and branch chiefs are aler and briefed on the accident. By method, all key personnel have p knowledge of the mishap, and v able time is saved.

By the time the staff meeting called to order, all information taining to similar accidents, or a dents in the same general locale, been gathered in order that proper vestigative plans may be formula Brig. Gen. Richard J. O'Keefe, rector of Flight Safety Resea after conducting a comprehensive cussion with his staff, decides th team will investigate the acciden

The team would include represe tives of the Medical Safety Divis Operations & Facilities Branch, Cargo Branch, and the liaison of from Air Weather Service, since t appeared to be a weather factor volved in the accident.

Chronologically, things happ about like this:

The Chief of the Records and tistics Division brought to the m ing a complete rundown of re



**The Office of The Inspector General, through its three directorates, is concerned with the concept of USAF accident preven**

**a major accident occurs, it is ssed in the daily staff meeting ucted by Brig. Gen. Richard J. efe, where determination is made whether an investigation team e sent to the scene of the mishap.**

ents involving the same type of aft, accidents occuring along the route, and other pertinent infor- on of value in determining what ened. In addition, all flying bio- hical data concerning the rated bers of the crew is made avail- to General O'Keefe. This came the more than 75,000 Form 5's le in the Directorate.

nce the R&S Division also main- a complete file of accident re- (Forms 14), any additional in- ation desired about similar ac- ts may be obtained within a few s by making a series of IBM s." In this manner, all cause rs of past accidents may be sum- zed in an attempt to discover in trends involving the specific ane or route in question.

rther significant details about the lent were furnished by repre- tives of the Cargo Branch, which tains an action log of all cargo lents, and particularly by the ect officer for the airplane. It was then determined that the project officer would be on the investigating team.

Since the airplane crashed approximately 30 miles off course, navigational error, and possibly weather, were assumed to be probable cause factors. As a result, a specialist on navigational aids, the liaison officer from Air Weather Service, and the Chief of the Operations & Facilities Branch, attended the meeting. The aeronautical charts of the area, Radio Facility Chart, and pertinent NOTAMS were furnished for further discussion. In addition, the airplane's route was plotted and compared with existing weather maps to learn where the possible navigational error took place.

In the case of the C-47, it was decided to send the navigational aids specialist and the AWS liaison officer along as members of the special investigating team. As an additional aid to the team, a resumé was prepared which summed up recent navigational error accidents in the same general area, involving C-47's and other aircraft.

Prior to the meeting, the Medical Safety Division sent a message to the Flight Surgeon at Wilco AFB, requesting all pertinent information involving any possible medical factors, or personal equipment malfunctions. Medical Safety, in this case, was also particularly interested in survival activities, in order that further research could be conducted as to existing and future clothing, and food and shelter provisions.

In addition, the base Flight Surgeon was queried as to any factors in the crew's background which would have a psychological or physiological bearing on the accident.

As soon as all interested division and branch chiefs presented their opinions, further discussion was held to add as many facts as possible, to be taken to the accident scene by the investigating team. Complete instruc- a few hours the team was on its way. hours the team was on its way.

Upon arrival at the scene, each

**Individual Flight Records (Form 5's) are microfilmed for permanent retention in Flight Safety Research files.**

team member was directed to perform his phase of the investigation according to his specialty. Then all the data and testimony were pieced together to form the most logical conclusions upon which to base sound recommendations.

In the C-47 accident, the Flight Safety Research team made the following findings:

- The most probable cause of the accident was navigational error.
- A contributing cause of the accident was that the winds were incorrectly forecast.
- A probable contributing cause was precipitation static which made radio reception impossible.

The team also made the following recommendations:

- That the minimum altitude over the route be raised to afford ample terrain clearance in the event aircraft were off-course.
- That continued study be made to develop radio receivers that eliminate precipitation static.
- That a procedure be established with the CAA to provide northbound aircraft calling Blank Radio with the latest en route weather to Wilco AFB.
- That additional radio aids to navigation be installed along the route.

The Directorate of Flight Safety Research was established at Norton AFB, California, as a staff directorate under The Inspector General, USAF, in February, 1950. Military pilot engineers and investigator-analysts were assigned to perform accident investigation and evaluation duties.

Officers, airmen, and civilians talented in editorial and graphic arts were procured to produce educational media and accident prevention presentations, under the direction of the Chief, Safety Education Division. FLYING SAFETY magazine. *The Aircraft Accident* and *Maintenance Review*, and Flight Safety posters such as Rex Riley, Crash and Consequences, and special publications are all produced in this division.

Highly qualified civilian specialists were obtained from such agencies as the Civil Aeronautics Board, other governmental agencies, and civilian educational institutions to perform duties requiring professional talent in the fields of physiological and psychological research, and engineering and statistical analysis.

From this nucleus of specialized talent, the Directorate of Flight Safety Research developed the organization to provide for its exhaustive engineering investigations of accidents, the scientific evaluation of aircraft accidents reported from Air Force units, specialized research into human factors involved in accidents, the production of improved educational media, and the development of records and statistical systems designed to produce realistic cause factor information.

In order to accomplish its mission, the Directorate of Flight Safety Research frequently calls upon the other directorates which comprise the Office of The Inspector General at Norton AFB—The Directorate of Readiness and Materiel Inspection and the Directorate of Procurement Inspection.

The Directorate of Readiness and Materiel Inspection was activated in 1950, charged with the responsibility to "conduct inspections to determine maintenance capabilities for aircraft and related equipment; inspect and evaluate maintenance techniques to eliminate adverse conditions and recommend improvements in maintenance practices and systems, and to evaluate command maintenance inspection systems."

The role of this directorate was particularly important in the overall accident prevention program, which enabled the Air Force to attain a new record low in accidents during 1952. The Directorate supported the program of the Directorate of Flight Safety Research by conducting studies which isolated areas of maintenance deficiences that were potential accident producing factors. The two
rectorates complement each other.

The Directorate of Procurement
spection has as its mission the e
cising of inspection surveillance o
the administration of the Air Fo
Industrial procurement and local
chase programs. The mission is
complished through inspection
contractor facilities and procurem
functions of Air Force organizati
and by surveys of specialized
Force programs.

The three Directorates work
close cooperation, with a prim
objective being a constant reduc
of aircraft accidents. Actually, it b
down to a few simple facts. Proc
ment monitors the acquisition of
Air Force equipment, with safet
primary requisite. Readiness ins
tion monitors all maintenance ac
ties to assure that operational eq
ment is maintained in a safe man
Flight Safety is primarily conce
with the personnel and equipn
utilized in operational organizati

The all-time low 1952 aircraft
cident rate obviously reflects the
bined efforts of all members of
Air Force in the field, and that m
*YOU!* Personnel of the Office of
Inspector General (and that m
*US!* like to feel that we have
rendered a valuable assist.

We're well into the third mont
1953—a year that could become
other milestone on the accident
vention road. We've all joked a
the recruiting posters—the poi
finger—and the statement that U
Sam needs *you*. Well, he does
you, and your cooperation, to e
nate accidents. The *time* is now,
the *place* is any place you happ
be. Only by working together—
team—can the ultimate accident
vention goal be reached. ●

### *Industry Cooperation*

Assisting in reaching th
overall objective are appro
mately 15 full and part-ti
representatives of major a
frame, engine, and other co
ponent manufacturers. The
specialists work in close coo
eration with investigators a
research personnel in determi
ing cause factors of accide
and gathering design factor
formation to transmit back
factory engineering groups, a
also work with investigators
the field as part of DFSR tea

The Medical Safety Division, left, deals with all human factors of aircraft accidents, plus survival and other personal equipment. Technical representatives work in cooperation with rated military specialists in investigations.

The Engineering Branch, left, is part of the Investigation and Safety Engineering Division. The Records and Statistics Division, right, maintains a complete record of all accidents, cause factors, geographical locations, and other important factual data.

/Sgt. Steve Hotch, left, who
aws "Rex Riley," gets technical
lp from one of the many manu-
cturer's representatives, who
ork with the Directorate of
ight Safety Research. The Safety
lucation Division, right, is re-
onsible for all publications.

# Time Equals Distance Over Speed

This is the navigator's formula for Time . . . the conception of flight reduced to a simple equation. But Time cannot be all things to all men. As the tempo of our living increases its beat, Time makes up a new set of values, and our day's existence resolves itself into more and complex pigeonholes.

To those of us who live by the control column and the rudder pedal, Time has taken gigantic strides, and faster ones. Today we must find time to cram into our minds every last ounce of knowledge that will tend to make us better, and safer flying men.

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Now you may receive your personal copy of Flying Safety Magazine each month on a subscription basis. Your application should be mailed to the Superintendent of Documents, Washington 25, D. C. The annual subscription price is $2.50, with seventy-five cents added for overseas mailings. We feel that Flying Safety is worth many times this price to those who believe in keeping up with Time, the safe way!

**Keep Up With The Times—Take Time To Read**

**FLYING SAFETY**

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# FLYING SAFETY

UNITED STATES AIR FORCE

APRIL 1953

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**seeing RED in the cockpit**
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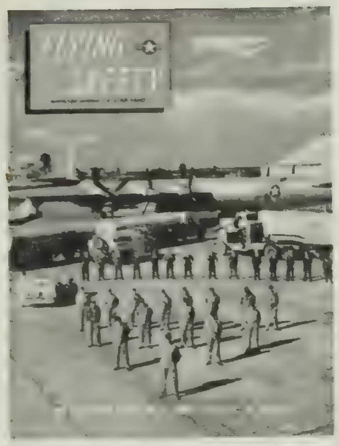

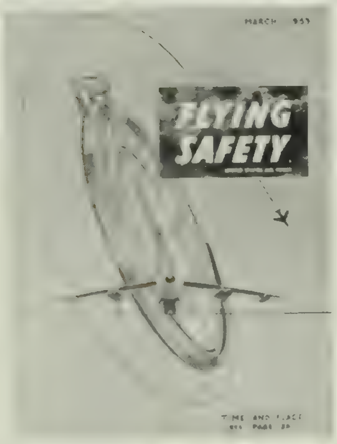

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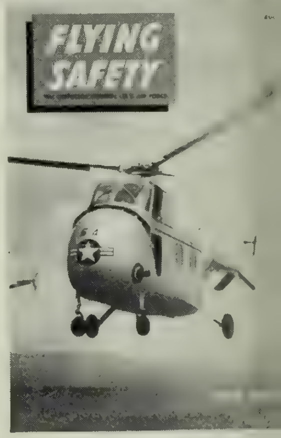

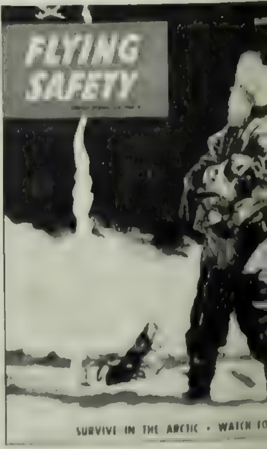

)L. 9 NO. 4 APRIL 1953

# FLYING SAFETY

partment of the Air Force The Inspector General USAF
Major General Victor E. Bertrandias,
Deputy Inspector General

☆

Brigadier General Richard J. O'Keefe, Director
Directorate of Flight Safety Research
Norton Air Force Base, California

☆

Lt. Col. John R. Dahlstrom
Supervisor of Flight Safety Publications

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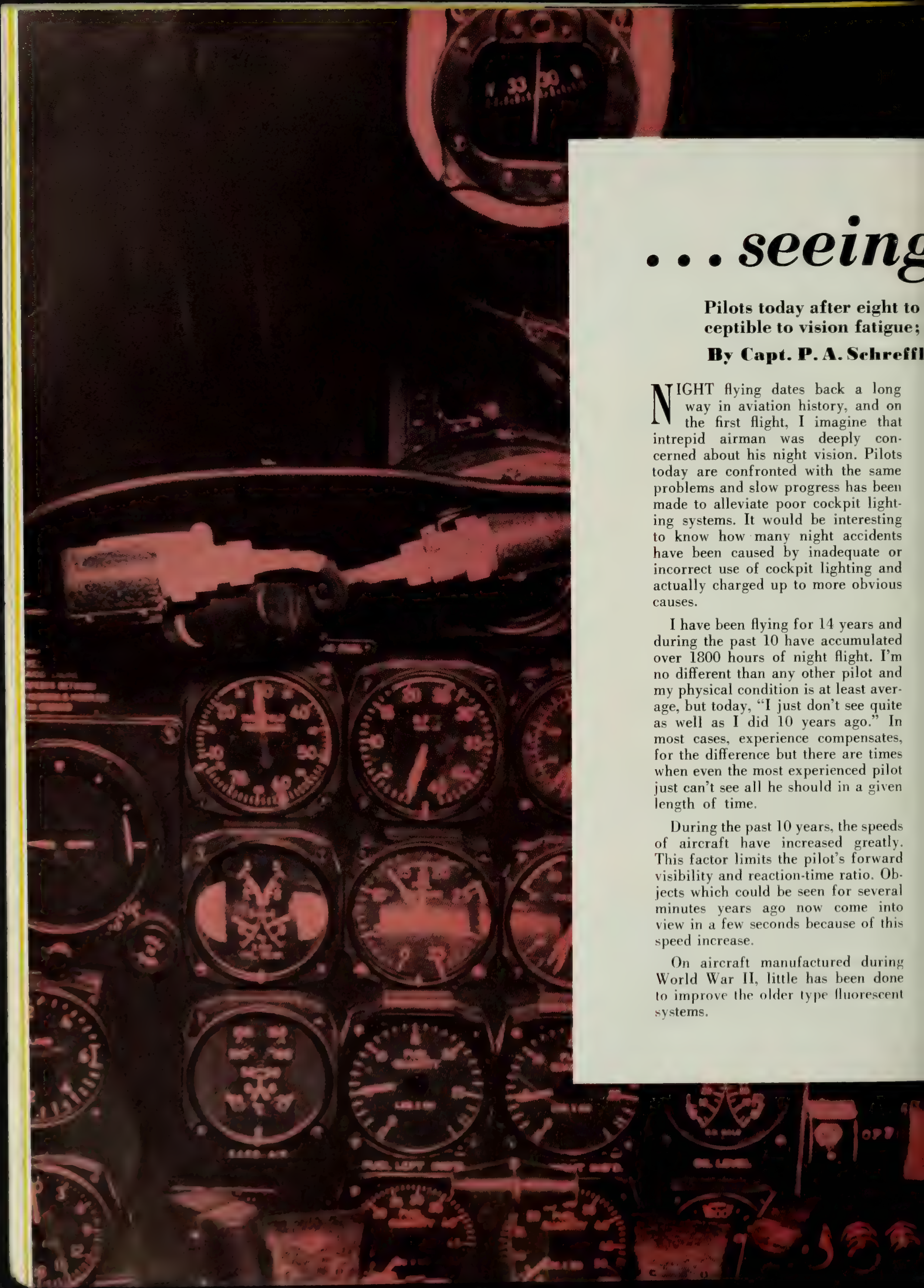
***Upcoming*** . . . in the weeks ahead we have some fresh slants on lightning strikes on aircraft in flight, survival in the jungles and tow-target techniques. Meantime, we'd like to call your attention to the parachute test article in this issue. If nothing else you should be a lot more 'chute conscious after reading about the testing techniques.

***The problem of*** cockpit lighting is always good for an argument in pilot circles. Captain Schreffler, in his pitch for better lighting for more safety, comes up with a good approach to the issue and at the same time offers his own design for instrument panel lighting . . . but you read the story for yourself. It's a fine presentation and begins on the next page.

***The Well Done*** for this month falls into the global bomber class . . . and covers the proficient handling of a B-36 emergency in flight. We would appreciate getting the good word on more well-dones when they do occur. Original art layout and a letter of commendation from the Director of Flight Safety Research goes to the pilot or crewmembers involved.

***Air Force writers,*** professional or amateur are welcomed in the pages of FLYING SAFETY. Don't worry about your writing style, the editors will work it over for you. If you have an experience or an idea like Capt. Schreffler's on Page 2, send it along!

**Here, an airborne team gets ready to make a desert jump. Turn to page 16 for the story.**



# . . . seeing

### Pilots today after eight to
### ceptible to vision fatigue;

### By Capt. P. A. Schreffl

NIGHT flying dates back a long way in aviation history, and on the first flight, I imagine that intrepid airman was deeply concerned about his night vision. Pilots today are confronted with the same problems and slow progress has been made to alleviate poor cockpit lighting systems. It would be interesting to know how many night accidents have been caused by inadequate or incorrect use of cockpit lighting and actually charged up to more obvious causes.

I have been flying for 14 years and during the past 10 have accumulated over 1800 hours of night flight. I'm no different than any other pilot and my physical condition is at least average, but today, "I just don't see quite as well as I did 10 years ago." In most cases, experience compensates, for the difference but there are times when even the most experienced pilot just can't see all he should in a given length of time.

During the past 10 years, the speeds of aircraft have increased greatly. This factor limits the pilot's forward visibility and reaction-time ratio. Objects which could be seen for several minutes years ago now come into view in a few seconds because of this speed increase.

On aircraft manufactured during World War II, little has been done to improve the older type fluorescent systems.

# ED in the cockpit

**of flying service are much more sus-**
**ckpit lighting could ease the strain.**

**f Pilot, 35th ATS, (MATS)**

Commercial airlines today use fluorescent or ultra-violet lights as secondary lighting only, the original and aviation-wide cockpit lighting system being augmented by white and red instrument panel lights.

But in military aviation the fluorescent lights still prevail. All pilots know of the ever present "Blue Haze" in the cockpit at night, the "Blue Tinted Windshield" when looking for that other VFR aircraft in the pattern, that blind feeling when you try to read an instrument at the bottom of the panel. Attempts to add white lights to certain World War II transport type aircraft have helped in a definite move towards better cockpit lighting.

### Typical Flight

But let us use a typical flight to illustrate the need for better internal lighting systems. Take for an example, an all night flight from Westover AFB, Massachusetts, to Harmon AFB, Newfoundland, with only the standard fluorescent system of a C-54 type aircraft. We'll start first in our crew positions with the "Before Starting Check List," which includes "Cockpit Lights—On." The remaining items are read, and the copilot engages the number 3 engine starter switch. Instantaneously the cockpit is completely dark, because the APU is unable to carry the load of all required electrical units. The engineer quickly grabs his flashlight to see if the instruments on number 3 engine are normal and in doing so innocently blinds either the pilot, the copilot or possibly both. All hands then scramble toward fluorescent switches to attempt raising the light intensity on the completely blacked out panel. With good luck this condition may only happen one more time during the starting sequence of the other engines.

Now we read the "Before Taxi Check List" and again the flashlight is employed so as to see what should be read. There are overhead lights, which, if turned on, completely remove from view any outside ramp activity.

Engine run-up on the taxiway near the end of the active runway is sometimes distracting, our age-dated cockpit lighting system is no match for the landing lights of the aircraft on the opposite side of the runway taxiing into position. With flashlights beaming, so as to clearly read the tachometer during mag check, we complete the "Before Take-off" check and await our ATC clearance. As the latter is copied, a climb restriction is added: "Make your climb from 2000 feet to 6000 feet VFR; if not possible, maintain a position VFR and advise." Right then and there a smart pilot would advise that he couldn't climb VFR since his night vision has already been pretty well destroyed, but anyway we'll go ahead.

We now line up the aircraft for takeoff and find that the runway lights, though the tower has them turned down to the lowest intensity, look like several hundred search lights all pointing in our cockpit. We quickly open the shields on six fluorescent fixtures in order to see our basic instruments clearly, and down the runway we go.

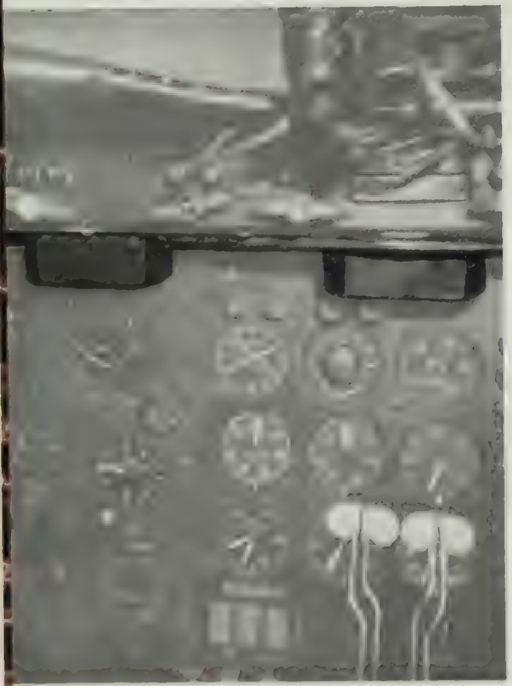
The C-54 becomes airborne and quickly overflys the end of the takeoff runway. A new hazard has now confronted us — too much cockpit light, limited forward visibility caused by that "Old Blue Haze," so the six fluorescent shields are closed and we climb toward the Gardner Intersection. After reaching 1,000 feet, the pilot asks for the "Climbing Check List." Flashlights again come into play and forward visibility is lowered to about the third rivet in front of the windshield (remember we're climbing VFR from 2000 to 6000 feet).

### Shields Opened

You wonder if the inbound traffic from Gardner to Westover is encountering the same flashlight blindness while reading their "Cruise Descent" check list. So with a course that will keep you well right of the climb-out leg you blindly climb from 2000 feet to 6000 feet.

The weather is good and below are seen a multitude of brightly lighted cities. In order to see the instruments clearly, the six shields are partly opened in an attempt to equalize outside conditions. Thus the "Blue Tinted Windshield" is now in effect to cause burning eyes and a very limited night vision.

**Cockpit here shows shield lighting units as designed by Capt. Schreffler.**



> *The eye physiologist can agree wholeheartedly with Captain Schreffler that a white and red floodlighting system would be superior to the present fluorescent system, according to H. W. Rose, M.D., Opthalmologist with the USAF School of Aviation Medicine. If adaptation of the eye should take place, the white light should always be used at the minimum brightness compatible with the flying task. The red light, whether it be floodlight or fluorescent, will be useful only if real night vision should be obtained . . . for example, under a moonless sky. But then it is superior to any other kind of illumination.*
>
> *Orange fluorescent lighting is an acceptable compromise when red lighting is unobtainable.*

Halfway on our route we encounter towering cumulus (not forecast) and with the high overcast and "Blue Haze" the cloud tops are "felt" before being seen. The cumulus grows in intensity and lightning flashes dance across the sky. The six lighting shields are opened again and even at best the fluorescent lights only slightly cancel the great brilliance of the lightning flashes. Naturally during this period internal cockpit vision is limited, but we manage to keep the aircraft somewhat straight and level.

"Between-layer" conditions now exist and we close all the six lighting shields and attempt to adjust the lights to a lower intensity by use of the fluorescent switches, instead of the shields. In doing so at least half of the lights go out completely and have to be restarted, and try as we may, we never do get a really comfortable level of lighting internally to compare with the outside black condition.

Continuing on, we start our descent at the gulf intersection and because of the reported weather, elect to make straight in range approach from St. Georges. Clearance is obtained and descent continued to 1500 feet at which time it is determined, by the lack of the light turbulence, that we are now beneath the overcast. It is fairly dark outside and even at 1500 feet, it is impossible to see the water surface below. If we turn down the lights so as to see outside, we can no longer see inside.

The "Cruise Descent" and "Maneuvering Descent" check lists are read. Overhead lights (hooded with red lenses) are used in place of the flashlight but the reflection on the windshield destroys even limited forward visibility.

About five miles out, we see the airport lights and landing clearance is requested. Now the lighting picture changes again because of the rapid increase of external light intensity. The six fluorescent switches are turned to "start" and the six shields partly opened to equalize inside and outside brilliance. As the engineer opens his shield, which illuminates the overhead panel, the cover comes off, leaving the bare bulb shining and almost completely blinding the three forward crewmembers.

### Final Approach

After a little fumbling, the cover is replaced about the time final approach is reached. Gear is down and the hydraulic pressure visually checked. To do this a flashlight is used by the engineer because no lighting facility has ever been installed to illuminate hydraulic panel instruments on the C-54. So the copilot gets the benefit of the flashlight beam. With his vision now almost at zero, he attempts to observe the last few hundred feet of the final approach with little success.

Touchdown is good considering all vision factors. But as the C-54 stops for a turn off the runway, (and before the engineer can start the APU) all the fluorescent lights have again gone out because of low RPM and no generator output.

The first portion (five hours) of the normal 13-hour work period from Westover, Mass., to Lajes, Azores, is completed. Eyes are tired and nearly the color of the cockpit lighting system.

Now let us start the trip all over, this time with a modern white and red lighting system and the fluorescents used as a *secondary* unit only. While starting the engines, the white lights are employed and even though they might dim down slightly, they don't go out completely.

The check list is held and read close to the instrument panel to utilize the already present white lights. Runup is completed after the white lights are adjusted to conform with external light intensity.

As you line up for the takeoff run, you adjust the white lights to equalize the runway lights by turning *just one* control knob, and the takeoff run is started.

As the runway disappears under the nose, you switch to red lights and forward visibility is kept to a maximum with no loss of internal vision.

The climb-out check list is read by red light illumination and that VFR climb from 2000 to 6000 feet is easily accomplished.

At level off, the white lights are again used and adjusted to balance the glow from the brightly lighted cities below. As the flight continues and external light intensity decreases, the red lights can be used again. With maximum available forward visibility, cloud tops are plainly seen in ample time to fasten passengers down before turbulence is encountered. As the build-up grows, and the first indication of lightning is observed, the white lights are turned on and as lightning intensity increases white light brilliance is turned up to full. With the lights so adjusted, the brightest flashes are barely noticed.

### Red Lights Used

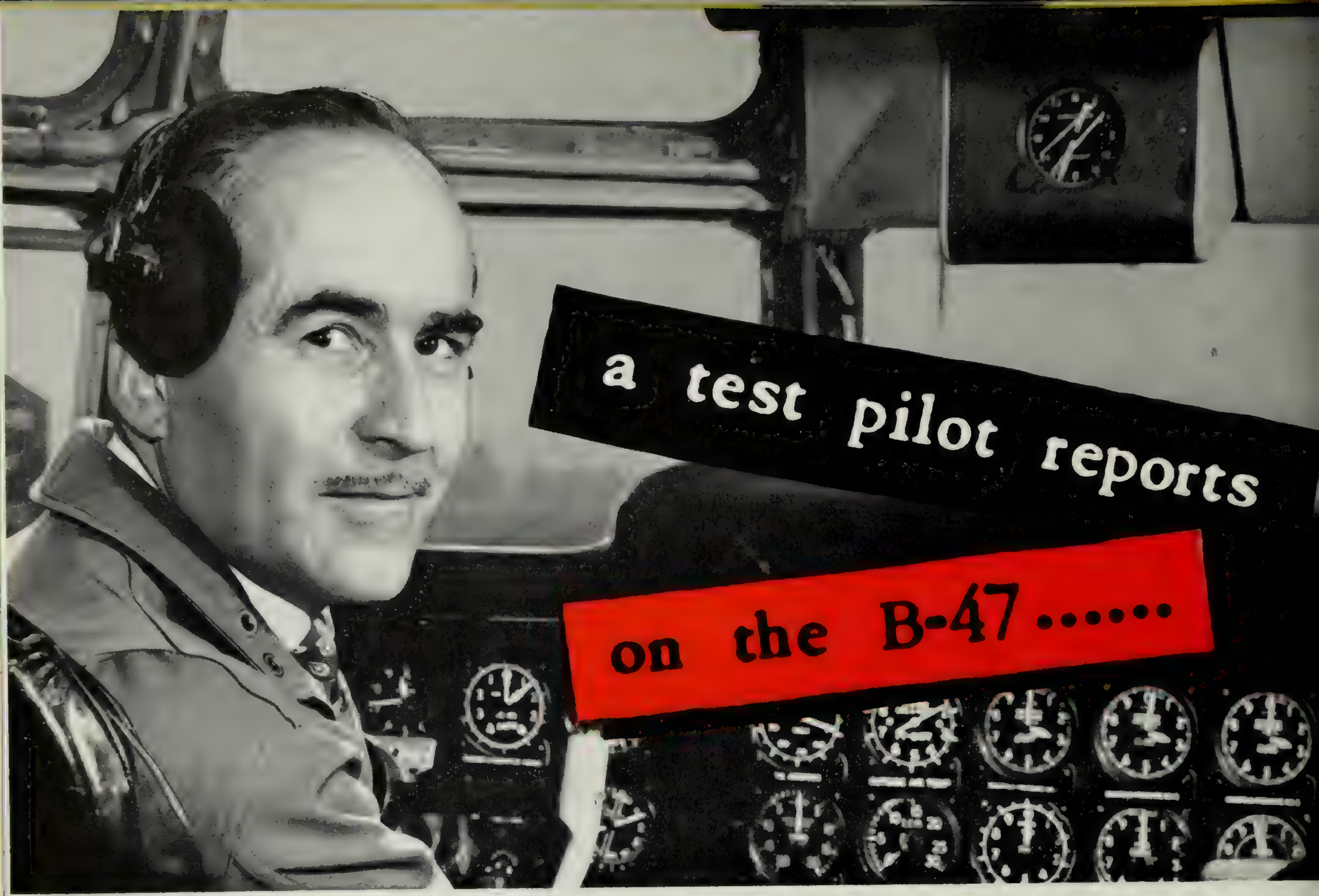
In not too long a time, the turbulence subsides and Charlestown is passed, we now enter the area of between-layer conditions. The red lights are used again and our vision is soon adjusted to both external and internal conditions. The remainder of the flight is routine, the water surface is visible at 1500 feet, white lights are used in the pattern, with no overhead lights needed to read check lists.

Although the examples cited are typical flights, they do illustrate many of the cockpit lighting problems confronting pilots. Installing a red and white cockpit lighting system is comparatively simple. I have designed and constructed a simple system made from available parts, and have personally flight-checked this equipment on trans-atlantic and trans-continental flight with great success. With some slight changes, this system could be installed in nearly all USAF aircraft. A better cockpit lighting system would offer these advantages:

- Eye fatigue is minimized on long flights.
- Color intensity is equalized on surface and cockpit lighting.
- Night vision is improved on overwater flights, or between cloud layers.
- In thunderstorm activity internal white lights prevent "lightning blindness."

From experiences gained in airline flying, pilots are assisted by installations of more adequate cockpit lighting. On commercial airlines the use of fluorescent lighting today is of a secondary or emergency nature. White lights should be used to duplicate "Outside the Cockpit" conditions. In other words, if you are flying over the New York area with its great array of lights, attempt to establish a white lighting level of equal intensity in the cockpit. Over the open water or between cloud layers, a red system is extremely beneficial, the intensity varied so as to create maximum forward visibility and maximum cockpit vision. Takeoffs from Island Bases which have standard white runway lighting is extremely difficult with only the fluorescent cockpit systems. With white lights adjusted in the cockpit to equalize the runway white lights, the takeoff run can be made with maximum vision. As the aircraft becomes airborne, and the runway lights disappear under the nose, the red light portion of the instrument panel lighting system is switched on and forward visibility is increased quickly by several miles. So, in summary, use white lights inside when white light prevails outside; use red lights internally during the absence of white external light, and at all times use fluorescent lights at a very low intensity as an emergency measure in case either white or red lights fail. ●

**A good system of approach lighting can go with better cockpit lighting.**



# a test pilot reports on the B-47......

### *About the Author*

*John B. Fornasero, chief of Boeing Airplane Company's flight test section, has been an experimental test pilot for the B-17, B-29, C-97, B-50, Stratocruiser and the B-47 Stratojet since joining the company in 1943.*

*An accomplished pilot with approximately 7,000 hours of flight time, Fornasero started his career in the aircraft industry in the maintenance division of Ryan Aeronautical Company in San Diego and later became head of that department. He learned to fly in San Diego, became an instructor and then head instructor. He later became chief of the Ryan test pilots and was active in testing early models.*

*Before joining Boeing he also served as a test pilot for Fairchild Aircraft Corporation and was employed by the Civil Aeronautics Administration as a flight test engineering inspector.*

*He started with Boeing as a test pilot, later became project test pilot, and in the latter part of 1948 was made chief of flight test. The following year he transferred his activities from Seattle to Wichita, Kansas, as chief of flight test for the B-47 program, and remained with the Stratojets until last March, when he returned to his Seattle office.*

*He is the head of an exceedingly busy department which has put in more than 5,000 hours of test and research flying on the B-47 alone. At the moment, Boeing is conducting various test on four different models—the B-52, B-47, B-50 and B-29.*

***By John B. Fornasero, Chief of Flight Test, Boeing Airplane Company***

FROM the very outset, flight testing of the Boeing B-47 Stratojet has been an exceedingly interesting business. For one thing, there have been the many new handling characteristics of this airplane, and for another, the swept-back jet has taken us to new horizons in bomber performance.

From the start, too, flying safety has been emphasized. From our early engineering studies to an unusually extensive pilot training program, safety has always been a major consideration. While the airplane was still on the drawing boards, designers were keeping in mind a prime requisite—it had to be fast but it had to be safe.

During early flight tests that the company made, we explored the major factors of safety operation as soon as we could and then went on to more detailed evaluation such as performance and airspeed checks and getting technical data that would confirm the wind tunnel predictions.

We also used a B-29 to simulate jet landing characteristics.

It was known that the typical flat landing approach of jet airplanes is, to a large extent, the result of high idling thrust of jet engines and lack of propeller windmilling drag combined with low airplane aerodynamic drag. So the engines of the B-29 were operated at the proper RPM with the props in fixed pitch, partial flap extension was used to simulate the B-47's stalling speed, and with essentially the same weight and braking available as on the B-47, a few answers were acquired.

### Some Answers

One immediate answer was the importance of maintaining correct approach speeds. Another was that by so doing emergency landings could be made on moderate-length fields, if required. Since then, of course, both the drag 'chute and anti-skid device have been developed as further landing-safety aids.

Intensive training of flight crews for the B-47 has been conducted since the airplane was ordered into production, and because of that very intensity the impression apparently has arisen—especially on the part of the layman—that here is a terrifically tough airplane to fly. B-47 pilots, I believe, will refute that. True, like all jets, it is more demanding in the need for anticipation on the part of the pilot, and he must be right on his airspeeds and his approach altitudes and attitudes. The fact remains, however, that the typical pilot comment describing the 185,000-pound B-47 is that "she flies and handles like a fighter."

**Intensive training of flight crews for the B-47 has been underway since the airplane went into production. Most pilots say, "she flies like a fighter."**

A double wall that contains the pressure cell and allows the crew to be at the equivalent of 8,000 feet while flying at 35,000 feet, keeps a large amount of the sound out. The control surfaces are powered to overcome the enormous air loads at high speeds. The pilots need only exert a small force, which is transmitted to a boost package that interprets the force reaching it and translates it to degrees of displacement of the control surfaces. Vibration is practically nonexistent because of the enormous reduction of moving parts, including propellers, pistons, connecting rods and associated mechanisms.

As for comfort, heaters keep you warm and refrigeration systems keep you cool. In short, you are comfortable, at ease, and probably not quite as hard at work as some imagine. The main problem is navigation, since the radio stations go by so fast that you constantly are tuning the radio compass to keep track of them.

There is a very definite safety feature, too, in the manner in which the engines are slung in "pods" beneath the wings. During early design studies there was considerable concern over the vulnerability of jet engines to gunfire. It was felt that the fire hazard of engines contained wholly in the body was not acceptable, and as a result the manufacturer started studies on external nacelles and various alternate external locations on the wing.

With swept wings and the externally-mounted jet engines, the experimental XB-47 test models took shape and began to look very much like the present production airplanes. It was also discovered that the pod type jet engines, mounted under the thin wing, did not interfere with air flow around the wing, and allowed extremely high speeds for an airplane of this category.

### Characteristics

Briefly, here are a few handling characteristics as they would appear to a pilot experienced in multi-engine operation who has also flown jet airplanes and is ready for checkout in the B-47.

The cockpit resembles that of a fighter because of the canopy and tandem seating arrangement. The pilot has exceptional visibility over the nose

**Both the drag chute and the anti-skid wheel brakes slow the landing B-47.**

and both sides, as well as above and aft. Flight controls are conventional, and have the large mechanical advantage required for emergency operation with power-servos off. The throttles are clustered together on the right stand for easy grip by one hand.

The instrument panel has the standard flight group and also the instruments for the six engines. The fuel panel is of the diagrammatic type, with gages, valves and warning lights. First impressions may be that the pilot is impossibly overburdened by six-engine operation, but several factors show this to be otherwise. Each jet engine is operated by only one lever affecting power, as against four controls on the usual reciprocating engine-propeller combination. In addition, the two or more controls on various cooling air outlets are all absent on jet engines. Standard systems have been designed to require a minimum of attention. Examples are a comparatively simple fuel system, flap retraction and extension speeds consistent with the airplane's requirements, thus avoiding the necessity of "milking" the flaps up or down, minimum longitudinal trim changes, and light stick forces for easy one-hand operation of the flight controls.

Takeoffs are made with full flap, and at the "unstick" point the airplane flies off the ground with the elevator near neutral, very similar to the B-17 or other tail wheel airplanes having a low ground attitude. One important point on takeoff is the comparatively long ground runs, particularly on hot days. This is due to the constant thrust characteristic of jet engines as well as the fact that the great power of the jet engine in flight permits high airplane loadings.

However, once airborne the critical emergency characteristics so notorious on over-loaded reciprocating engine airplanes are much better on a six-engine jet plane. Once in flight things get better in a hurry on the jet.

The characteristics of an airplane in rough air tend in the long run to have more eventual influence on a pilot's opinion than some of the more spectacular phases of flight. The B-47 is very much less disturbed by turbulence than non-swept wing bombers. One of the characteristics of swept wings is the load-relieving tendency of the wing tips, and in rough air wing flexibility is quite apparent. The pilots can see the wing tips and outboard nacelles "riding the bumps" while the cockpit is riding smoothly. Such a characteristic, of course, provides a more stable bombing — and riding — platform.

### Faster Landings

By far the most training of jet pilots must be spent on the landing phases, a necessity because of several factors. The very high level flight speed requires a longer time for the airplane to slow down. The higher wing loadings possible in jet airplanes and the somewhat lower wing maximum lift result in higher stalling speeds.

Incidentally, stalling characteristics of the B-47 are good. Straight wing airplanes often have an abrupt stall, caused by the whole wing "letting go" at once, but this undesirable condition rarely exists on a swept wing where some sections hold on for a long time. Stall warning on swept wings is usually more pronounced, with a wider speed band, and because of this there is little excuse for inadvertent extreme stalls on the B-47.

Rapid descents from altitude are made with the landing gear down. The flaps are put full down in the landing pattern, which is slightly wider than for a B-29. On final approach the pilot must maintain the desired airspeed more carefully than on past airplanes to avoid using excessive amounts of runway and to still maintain an adequate margin over the stall.

Admittedly, one disadvantage of the tandem landing gear is that the speed range in which smooth landings can be made is more limited than on other types. It is obvious that with the tandem gear the airplane cannot be landed at a speed much higher than that for simultaneous contact of both gears. Touching the front gear first with an appreciable rate of descent will result in a bounce back into the air, or will at least prevent enough load being applied to the wheel to permit effective braking.

Why the tandem landing gear, anyway, it may be asked? For one thing, neither jet nacelles nor the wing are big enough for a main gear such as is required to carry the load of the B-47, but a gear retracting within the body is necessary. For another, a tricycle gear meeting this requirement has several disadvantages when applied to the B-47. It would make for a poor internal arrangement in that the main gears must be near the center of gravity, and when retracted in the body would be in the same place where the bomb load should be. Also, the tread would be narrow, giving poor protection to the wing tips.

As it is, the aft location of the rear gear affords increased protection to the tail and wing tips in a nose-high landing, while the wide tread of the outriggers provides good lateral stability.

All in all, with its simplicity, lack of vibration, smooth ride and comparatively low cockpit noise, the B-47 is a lot of airplane, and it appears that a lot of them are going to be flying in the future. ●

# THINK before you blast that throttle

A REFLEX ACTION with most F-51 aviators is to "clean out" that Allison at the slightest indication of roughness . . . you know . . . "give it the needle, 3000 and 61 . . . regardless."

There is no need to panic the first minute that purring monster starts to hiccup! Many an airplane with swallowed valves or broken valve springs has made a safe, albeit rough, landing. For instance, a tow ship recently made three passes at the field trying to drop the target, and all this time the engine had swallowed a valve. The pilot didn't jam on power to "clean out" his engine, he just let it run as long as he could. Yet, just the other day, a pilot, moments after having had *full power* for takeoff, jammed on full power again to "clean out" a slight roughness in the engine.

Here the result was that all the coolant spurted out the stacks, with a forced landing to conclude the caper.

T. O. 01-60J-70 is quoted as follows: "After each 30 minutes of continuous cruise operations:

- Clean out engine at 61 in. Hg., 3000 RPM for one continuous minute;
- Before landing: clean out engine at 61 in. Hg., 3000 RPM for one continuous minute."

When you advance the throttle, move it smoothly. If you still have a rough engine after the clean out, reduce the power to the best operating setting and head for the nearest runway.

The coolant system of the V-1650 engine used in the F-51 gives concern to men who fly it. The reason is obvious, but not so obvious as the reason for engine failures, particularly those failures that produce a burning through the side of the engine, which usually burns out through the side of the block in the area adjacent to No. 5 cylinder, both "A" and "B" banks.

A personal theory concerning this, based upon an attempt to lengthen the life of the engine, is submitted for the consideration of FLYING SAFETY'S readers.

The most important preflight check of the V-1650 engine is the check made of the coolant system contents, both header tank and after-coolant tank.

This check is made when the engine is cold and at this time, coolant is added when needed.

### Coolant Level Low

Let us now examine the system and determine what would happen if the engine were run when the main coolant system level is low.

The engine is located in such a manner that the combustion chambers are not surrounded by coolant if the coolant level is low. This is due to the nose-high, tail-low attitude of the air craft when parked.

If the coolant is low enough it will barely prime the main coolant pump.

We now start an engine that is low by about five gallons of coolant. We build a fire in each cylinder and the engine operates, but there is nothing to carry away the heat.

The engine continues to operate, and the temperature increases.

The coolant pump throws small amounts of coolant into the system and this hits the white-hot cylinder walls and vaporizes.

The steam, in turn, creates pressure in the system, the coolant expands, and after several minutes of operation there is sufficient expansion to carry coolant around the cylinders and cool the engine.

But, the *damage* has already been done.

Hot spots have been created in the coolant jacket and surrounding areas. These do not immediately become apparent, but they cause trouble *later* when the engine is asked to deliver a maximum load.

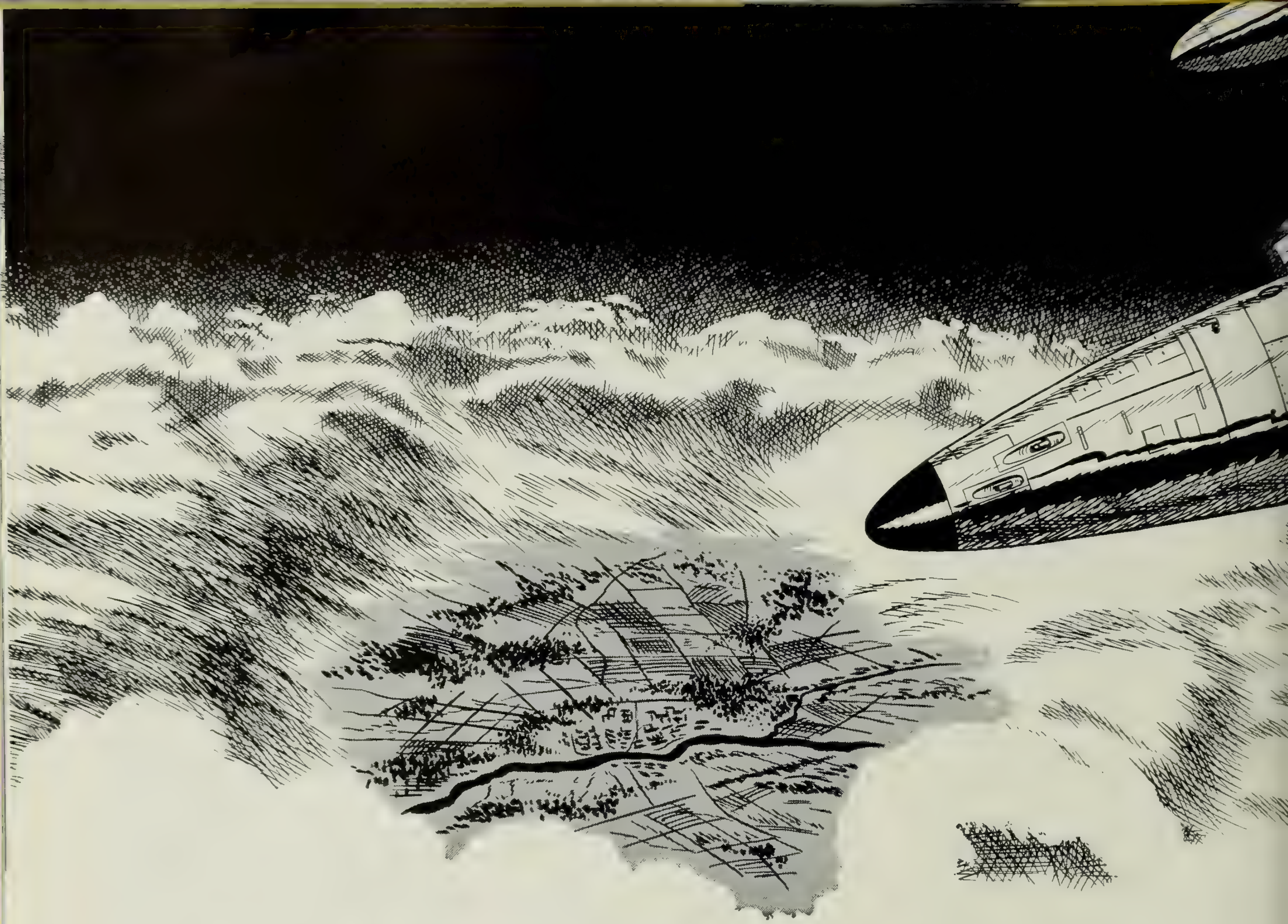
Probably you are now wondering why such a condition should be permitted, if the mechanic performs the preflight check.

The answer is that the *mechanic* performs the preflight check, but when the aircraft goes cross-country and RONs at a field where F-51 maintenance may not be readily available, the *pilot* may start the engine the following morning without performing inspection of the coolant system.

We have found, both through personal experience and through a survey of F-51 mechanics, that a slight coolant leak, plus a wind to aid in evaporation, will lower the coolant level in the system by several gallons in a 12 to 18-hour period without an appreciable amount of coolant showing on the ramp under the airplane.

In my opinion, we can substantially reduce the number of failures on the V-1650 type engine if the pilots going cross country would check the contents of the coolant system before starting the engine.

Bear in mind that you just have to run an engine that is low on coolant *once* to start a chain of events leading to future trouble. ●



# weather wring out..

INTO the thunderstorm headed the F-84-G. Plotted by a special radar control unit, and in constant communication with ground control, the pilot of the airplane called in to advise that he planned to make several penetrations of the cloud at various altitudes. One hour later the F-84 slid down through the overcast, and finished up a smooth GCA run with a night landing on a rain-slick runway.

The pilot, a member of the Phase V Test Section at Wright-Patterson Air Force Base, climbed out of the cockpit, checked his aircraft for damage, and went back to his office to write up the fifth phase tests on the flight.

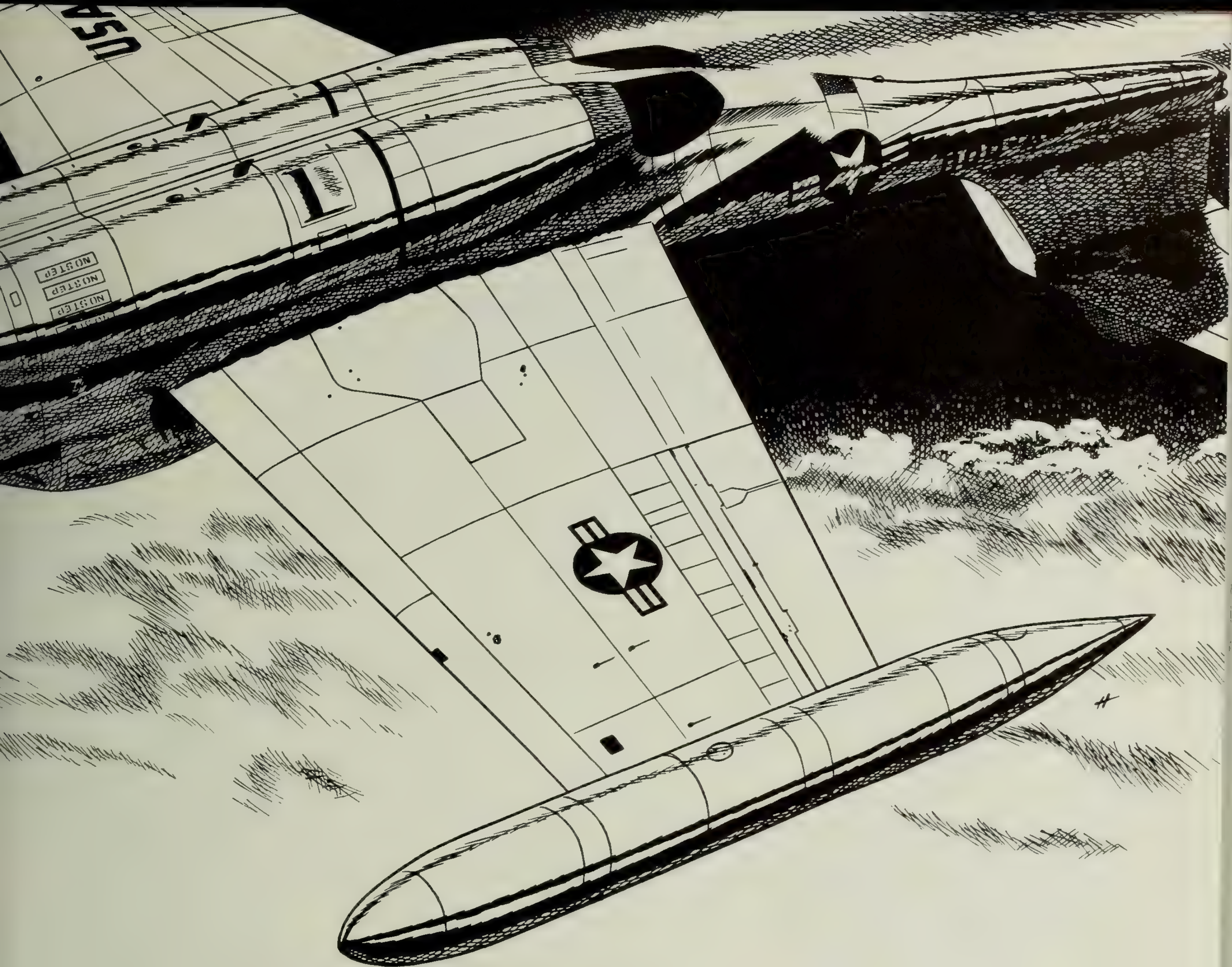
The mission of the Fifth Phase Test Section is to determine the all-weather capabilities and limitations of all new production aircraft. It is one link in the chain of exhaustive tests flown on all models and types of USAF aircraft from the L-19 to the B-47, to determine suitability for instrument flight.

Of equal importance to tactical units is the production of recommended pilot techniques and procedures for all phases of instrument flight which the aircraft mission requires. The ultimate goal is the achievement of an all-weather Air Force, capable of fulfilling the world-wide commitments of USAF combat units.

The Phase V Test Section participates in every stage of new aircraft development. When the aircraft is first proposed, two Phase V pilots are assigned, one as project officer, the other as an assistant project officer. The project officer is responsible for reviewing all the specifications of the proposed aircraft and decides whether or not they will meet the Air Force's needs, as they pertain to weather flying. The purpose of this is to get all the Phase V ideas on instrument needs into the plane design while it is still on the drawing board.

The project officer then goes to the mock-up board and acts as technical advisor on the all weather aspects of the aircraft. Here he will write up "requests for alterations" and submit them to the Board. Action must be taken by the Board on all write-ups either approving or disapproving the recommendations.

The third stage is the actual flying of the production aircraft at the factory. Evaluation tests are run, using all the standard test checks such as photo panels, wire recorders and radio to supplement the pilot's per-



sonal evaluation. A production model of the aircraft is then assigned to the Phase V Section and the project officer ferries it from the factory to Wright-Patterson.

After the tests are flown and the results compiled, two reports are written. One, the evaluation report, gives the findings of the tests from an instrument flying viewpoint, in outline form. Recommendations for changes and engineering data are included in this report.

The other report is actually the pilot's operating instructions, which are prepared and written for the "dash One" tech orders in the all weather section. This report is sent out to the field, after being thoroughly discussed and evaluated and approved by the Phase V Section. If necessary, the report is revised by the Operations Branch of the Flight and All Weather Test Division. The report is sent to the field prior to being printed in the tech orders so that tactical units will have the benefits of the findings as soon as possible.

### Units Advised

Finally, the All Weather Indoctrination Board sends the same pilots that participated in the tests to the tactical units scheduled to receive the aircraft. These pilots give a complete briefing on all phases of the tests and the results. Their lectures are supplemented with performance charts, slides, movies and question periods. Pilots of the tactical organization have an opportunity to question the test pilots on anything contained in the operating instructions or on any specific phase of the test. They are told just what will and what will not occur with different power settings and configurations while on instruments. Instruments in the aircraft are evaluated for performance and the test data figures given in detail. These briefings are important, in that a pilot who will be flying a given aircraft under weather conditions has an opportunity to discuss it with people who have flown it in adverse weather.

Target data on the actual test flying is geared to three months with approximately 75 hours flight time on the aircraft. The tests are concerned strictly with instruments and instrument flying, with specific tests outlined for each flight. For example, an aircraft is flown at a specified configuration to determine exactly how much fuel is needed to make two GCA runs after a letdown from altitude. The fuel used in each stage of the operation and the time consumed for each stage is then included in the pilot's operating instructions for that aircraft so the pilot will know exactly when to start the letdown and how much fuel he will have in reserve after shooting two GCA's.

The test program is divided into three stages:

The first or preflight stage includes the general planning, the proposed flight schedule, provisions and requirements for the reports and instrumentation.

The second or flying stage is divided into three parts: transition, VFR tests and IFR tests.

The transition starts with the project officer and his assistant being checked out in the aircraft at the factory. After ferrying the aircraft from the factory they check out the other pilots in the section.

The test pilots are required to make assessments and evaluations of the new aircraft even during this transition period, particularly after the first flight, as it is felt that first impressions are extremely important. In this primary assessment, eight points are considered. In general terms, these boil down to visibility, ground handling characteristics, takeoff characteristics, general handling and stability, approach characteristics, instruments and navagational equipment limitations, and night flying.

After this preliminary assessment has been made, a detailed program based on the information already obtained is drawn up to decide the limits within which the tests are to be carried out.

The VFR stage is to determine techniques to be used in carrying out the various phases of instrument flight before the practical tests are run under IFR conditions.

In the IFR stage the techniques and procedures decided upon during the previous stage are first tried out under the hood. This is done to check the VFR results under conditions where, if anything goes wrong, rapid recovery can be effected by removing the hood or goggles. During these flights under the hood, a safety pilot is carried in multi-engine aircraft while a pacer aircraft is used for fighters.

Finally, the tests are flown under all possible types of IFR conditions, using the techniques perfected in the previous test flights.

## Cross-Wind Landings Checked

Instrument takeoffs into the wind and cross-wind are made with various configurations and CGs used. Recommendations are made for the best trim settings both on takeoff and for initial climb after gear and flaps have been retracted. Climb to cruising altitude using different configurations, instrument settings and cockpit procedures are made many times to investigate and evaluate the aircraft's handling characteristics and the best trim settings.

Turns at low and high altitudes are performed with power settings varying from maximum continuous power to maximum cruise power and minimum allowable power. Determination is made of the maximum angle of bank allowable on instruments, best angle of bank, stability and control characteristics of the aircraft in an instrument turn, the IAS at the various power settings at cruise altitude, instrument turning errors, if any, and an evaluation is made of the flight instrument presentation.

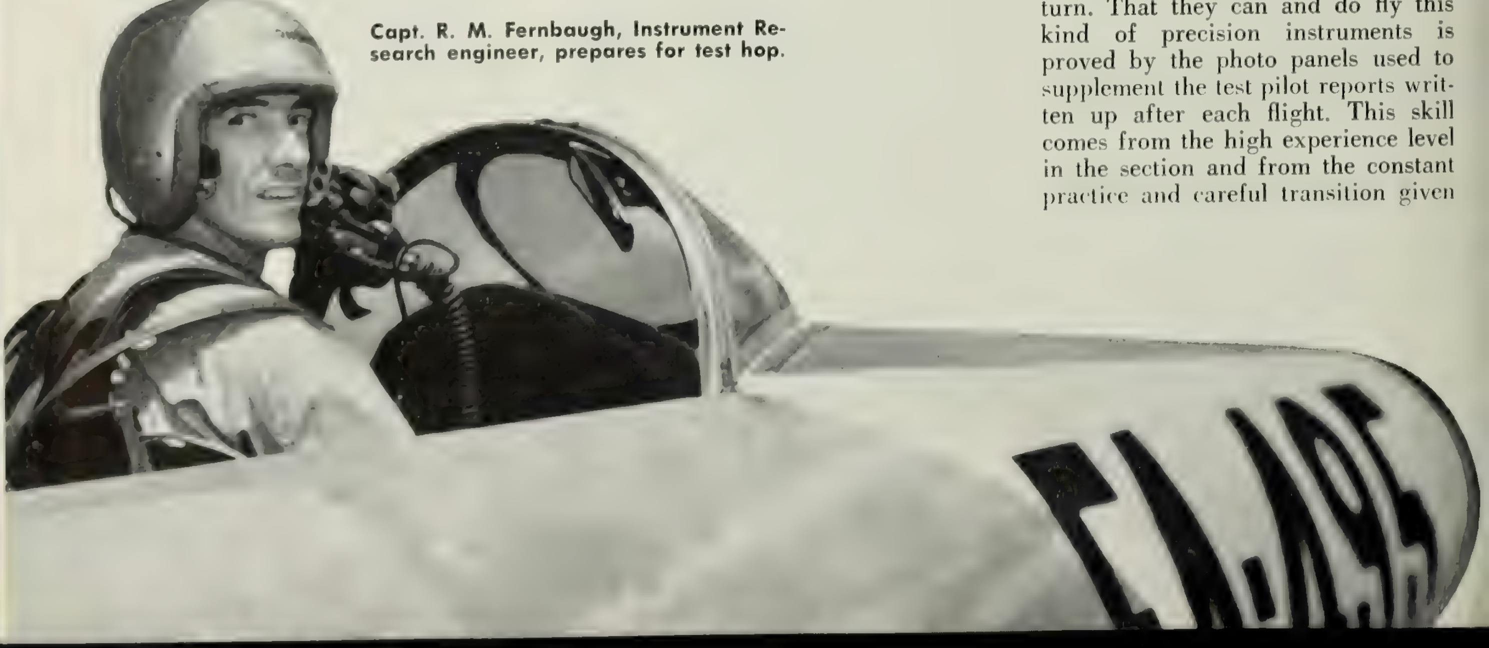
Letdowns are gone into in great detail, and standards are established for the best letdown airspeeds, the proper aircraft configuration, the maximum safe letdown airspeeds and for the recommended rate of descent. Included in this stage of the flight tests are the best angle of bank during descending turns, time of descent and the overall handling characteristics of the plane during the letdown.

Great care is taken to establish complete approach procedures, giving the same data as described for the letdowns, for radio range, non-directional radio beacon, GCA and ILAS approaches. An important part of the approach tests is a recommended ceiling and runway length for GCA approaches and the establishment of missed approach procedures.

Other tests include all types of icing conditions and turbulence, thunderstorm penetrations, unusual maneuvers and acrobatics on instruments, simulated operational missions and emergency procedures. All these tests are run under every possible configuration and weight condition possible to determine the aircraft's handling characteristics in any situation.

## Flight Safety Factors

There are many flying safety angles built into the test program. It goes without saying that all the Phase V pilots are extremely proficient in instrument and night flying. Typical demands on their flying skill include being told to hold the miniature aircraft on the artificial horizon exactly one-eighth of an inch above the lubber line or to hold an unwavering rate of descent and airspeed for a given length of time while maintaining a three-quarters needle width turn. That they can and do fly this kind of precision instruments is proved by the photo panels used to supplement the test pilot reports written up after each flight. This skill comes from the high experience level in the section and from the constant practice and careful transition given



Capt. R. M. Fernbaugh, Instrument Research engineer, prepares for test hop.

**All test flights are monitored oy Maj. O. W. Baron, Section Chief.**

**roject officers are given a horough factory checkout be-ore starting test program.**

each pilot on each aircraft to be flown.

Another aspect of the safety angle is the factory checkout given the project officer and his assistant. They are thoroughly indoctrinated in all aspects of the aircraft by the factory's test pilots and engineers. Upon returning to the base the project officer makes out extensive questionnaires on the new aircraft and discusses the plane thoroughly with the other pilots in the test section. Pilots fill out the questionnaires and any mistakes are gone into thoroughly to insure that everyone is indoctrinated in all aspects of the aircraft. Rigorous cockpit checks are given before first flight, after which the main flight characteristics and all emergency procedures are reviewed again. Finally, the project officer goes to the tower and controls the entire first flight.

### Check Lists Stressed

Check lists are continually stressed as all the Phase V test officers eventually fly most of the aircraft undergoing tests. While the project officers fly most of the tests on their assigned aircraft, supplemental flights are made by the others in the section to confirm and supplement their findings.

Another safety aspect is the excellent maintenance performed on each aircraft. An aircraft is given a real shakedown inspection before each flight, with the emphasis being on preventive maintenance. An example of the care given each aircraft is the preparation taken for a thunderstorm penetration test. Engineers in the structure lab make tests to determine the best penetration speed of the aircraft. Meanwhile the Phase V engineer runs independent tests to arrive at a figure which is cross-checked with the lab people. The test pilot is then briefed on their combined conclusions as to the proper penetration speed and told all the possibilities that may occur structure-wise in the thunderstorm under various conditions. In this respect, it has been found that a good rule-of-thumb penetration speed for most tactical aircraft is about 50 knots above stalling speed. However, this is not a steadfast rule for all aircraft.

All test flights are monitored on a two-way radio in the Section Chief's office. This enables him to check on all test flights from a safety angle as well as from a progress viewpoint. In the event of trouble, it is possible to make suggestions to alleviate or "fix" the condition as well as to change the test flight to meet possible emergency conditions.

An important part of Phase V work is the testing of old and new instruments in various aircraft. Frequently, new instruments are tested and evaluated in as many as seven aircraft before any final conclusions are drawn.

### Pilots' Eyes Tested

Another test program of interest to pilots is the instrument research tests being conducted in conjunction with the Aero Medical Laboratory. It involves the placement of instruments in the instrument panel in relation to eye movements by the pilot. Movies are taken of a pilot's eyes while he is flying instruments to determine which instruments he looks at more often and between which instruments the greatest amount of cross-checking and eye-shifting is noted. Accurate charts are kept to show which instruments the pilot is most dependent upon under all conditions of instrument flight. On all test flights, pilots are given special questionnaires to fill out on instrument panel arrangement and on any new instruments, asking for suggestions and improvements.

The purpose of the tests is to establish a composite instrument panel for future aircraft designs that will best suit the majority of pilots. It also sets up an interim panel modification that ultimately results in established and standardized cockpit layout. ●

# ...VFR ..IFR

### By 1st. Lt. Charles Konigsberg, 95th Fighter Interceptor Squadron, Andrews Air Force Base

DARKNESS had failed to lift the daytime siege of heat and the summer haze hung on like a hangover south of the Equator. Through the windows of his cab the tower operator could barely discern the navigation and fuselage lights of the F-94 flashing overhead even before he heard the call, "three-three-zero on the break." His reply was almost automatic. "Three-three-zero, you are cleared to land number two following a B-25 now on final. Call base."

The pilot acknowledged, "three-three-zero, roger." These were the last words heard from 330 that night—or any other night. The haze swallowed up the 94 and the pilot and radar observer it had carried on an intercept training mission.

Investigators could reach only one conclusion: The pilot had concentrated so on maintaining visual contact with the runway after his break that he had failed to check his altimeter or other instruments and had flown his airplane into the ocean on the downwind leg.

The young pilot had disobeyed what should be a cardinal rule of flying:

Don't try to fly contact and IFR at the same time.

When he broke from his initial approach and went over the water where there were no lights to give him horizon reference, he should have gone on instruments and remained there until he had established positive visual orientation on the downwind leg. In straining to look over his shoulder to keep the field lights in sight, he erred fatally. It takes little time to lose 1000 feet in a jet and this pilot ran out of altitude while his head was turned away from the instrument panel.

### Consider Formation

At times, fortunately, this kind of story has a happier ending. Consider for a moment a flight of four, in loose formation, on a cross-country training mission. On course ahead a cloud layer is observed. Leisurely, three pilots begin to close in on the leader to stay tucked in while flying through the clouds. But No. 4 hasn't quite caught up when the other three enter the layer. He pulls off about 30° and immediately thereafter penetrates the layer. He is still looking in the direction the others have taken when he finds he cannot interpret his instruments quickly enough to prevent the steep spiral he enters so suddenly. But Dame Fortune is perched on his shoulder. He loses 3000 feet but he is now below the cloud layer and is able to level out his fighter visually.

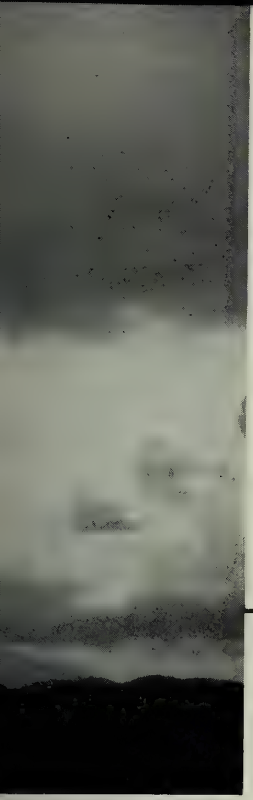
In other circumstances, the No. 4 man might not have been so fortunate. Yet the incident could have been avoided had he gone on the gages before he actually encountered the instrument condition.

In the sudden transition from VFR to IFR there is an element of risk, particularly the risk of vertigo. It is wise, therefore, to go on instruments in advance of the necessity, it being virtually impossible to be contact and IFR simultaneously. Stay on the gages and believe in them until absolute VFR is re-established.

There is on record the story of the interceptor that descended through a hole in an overcast and let down into a transport flying just below the clouds. The hole was large enough to permit a VFR descent; hence, the pilot's action was legal. But several men and two aircraft were lost permanently because he preferred a hole in the overcast to an IFR letdown.

The heart of incidents such as these is that it reflects an inexperienced and immature attitude which many pilots have toward instrument flying.

Surely, an anachronism must exist.



# .. ..and in between

Current training and policy are much improved over precept and principle of the past. And yet this progress, it seems, inadvertently dictates that the hole in the overcast is to be preferred to instrument flight. To be sure, it is axiomatic that the best way to fly weather is to avoid it. But is the hazard of flying instruments greater when the alternative is the hole in the overcast, especially if that hole suddenly is filled with another airplane, or gives way to a cloud with a granite center?

This is not an attempt to advocate unwise, or even unnecessary, weather flying, although parenthetically it should be noted that the satisfaction one feels upon completing successfully an instrument flight and letdown under exacting conditions is one of the highest rewards of flying. But we do fall short of promoting a mature attitude toward flying weather.

Our instrument training and schools are excellent; our techniques are without peer. But after the pilot has attained the required level of proficiency in basic instruments and procedures, it is primarily the psychology with which he approaches the challenge of actual weather that determines—in many instances—whether he survives, and whether he saves or loses a valuable airplane.

### Mature Attitude

To develop a mature attitude toward weather flying is not easy. One step might require that training schools conduct actual, supervised weather flying in addition to the in-and-out of thunderstorm flying so briefly accomplished now. The problem is not without solution, even for fighter pilots. The T-28 and T-33 are practical training aids when a qualified instructor is present. Moreover, it would be valuable were all pilot trainees—including single-engine men—to fly extended weather flights as copilots in multi-engine aircraft in order that they might acquire confidence in the gages.

Experience of this kind should teach the pilot to *think* IFR as well as to *fly* IFR. It should teach him that he can believe in his instruments, and it should teach him to use them. Apparently not all do. I recall a pilot who remarked, after a night training mission, that he was going back to his airplane to write up the fact that the turn and bank lights were out. Another pilot, who overheard the statement, exclaimed: "Holy cow! How do you ever notice those little things?"

Practical experience acquired in actual weather under competent supervision would be helpful to the young pilot in another way. It would teach him the importance of "visualization," that factor that the veteran weather pilot acquires and which enables him to know at all times his position in relation to the station and field on which he is letting down, not merely in terms of headings, distances, relative bearings and rate of descent, but "visually" in his mind's eye—as if he were performing the letdown VFR.

The new pilot who goes into multi-engine aircraft will have the benefit, usually, of an apprenticeship as copilot before he is called upon to command an aircraft under IFR conditions. He will have more time to learn and absorb at the knee of an expert.

But the young pilot, fresh from graduation, who goes into fighter aircraft will not have the same opportunity. Yet he has the right to expect supervision. By any other name, perhaps it will still spell out on-the-job training. I like to think of it as "supervised experience." ●

# 1000 JUMPS fo

**One for the money, two for the show—professional jumpers at the El Centro Parachute Test Center daily are making test jumps of new parachutes.**

THERE are many ways to make a living that do not appeal to the average man. Few choose to make a career of fighting bulls or getting shot from a cannon. Not many relish getting paid for walking a tightrope, sans net, or exploring the ocean floor in a diver's suit. And high on the list of jobs people don't want is the career of parachute tester. The professional Air Force and Navy jumpers at El Centro, California, swear that test jumping is a pretty safe occupation; they point out that the 'chutes have been tested with weights before they jump them and that they have a safety 'chute on in case something goes wrong. All of which is very true, but from the laymen's viewpoint it still is a career that takes much moxie on a day-by-day basis.

The men making these test jumps are part of a joint Air Force-Navy team whose primary mission is to test new parachutes designed for service use. The Air Force unit is known officially as the 6511th Parachute Development Test Group and the Navy's official title is Navy Experimental Parachute Unit. The responsibilities of the joint Air Force-Navy operation are divided equally between the two services. The Air Force operates the 140-foot drying tower, whirl tower, paragun and instrumentation lab while the Navy runs the wind tunnel, textile lab and machine and metal shops and is responsible for taking pictures of all tests. The fabric shop and packing loft are operated jointly.

### Typical Test Jump

A recent test jump illustrates the cooperation between the two services at the test center.

Primarily, the jump was made to

# afety

test a newly developed one-man life raft pack attached to a standard seat 'chute. This raft is designed for use in aircraft with restricted cockpit space. The aircraft used by the jump eam was a Navy C-47 flown by Air Force pilots, with a Navy jump master and three Air Force jumpers. Two Navy boats stood by waiting to ick the men up after they bailed ut over the Salton Sea, the area used or water jumps.

The two boats moved well away rom shore, checked equipment and ired a signal flare to notify the air- raft that they were ready to pick up the first jumper. The first man out merely made a drift jump. That is, he jumped to determine the wind drift so that the pick-up boats could be in position to get the jumpers as soon as they hit the water.

The two men fitted out with the experimental equipment then jumped in turn after signal flares were fired. The test was to determine convenience of the pack for wear in aircraft —does it creep up the wearer's back, slip from side to side, is it comfortable; effect of opening shock—does the pack stay on the wearer's back, is the material strong enough to retain the raft during opening shock: and the effort and time to inflate and board the life raft. As a further test, one jumper, Warrant Officer Lawrence Lambert who is an experienced parachute tester, and the other, Lt. Col. John E. Blake, Executive Officer of the Air Force unit, made his first jump. By matching the speed of the experienced tester against that of a pilot making his first jump it was possible to determine the feasibility of using the raft as standard equipment.

Primarily both test units at El Centro are concerned with new ideas and new designs, new clothes and new ways of using 'chutes. Over the past few years dozens of new 'chutes have been tested and failed to meet the rigid service standards.

Both the Air Force and the Navy units, as well as testing 'chutes, run training programs for new jumpers. These embryo jumpers are chosen from the men assigned to the various sections of the two units. They may be riggers, carpenters, photographers or in any of several other support functions when they start to jump. That they don't all qualify for jump wings is fairly obvious. Some don't have the aptitude to make successful test jumpers, some decide they don't like it as a career, and some turn up plain scared. The first five Air Force jumps are made using a static line operated troop 'chute, which experienced jumpers claim is actually a lot rougher than a straight free fall because of initial shock.

### Extensive Program

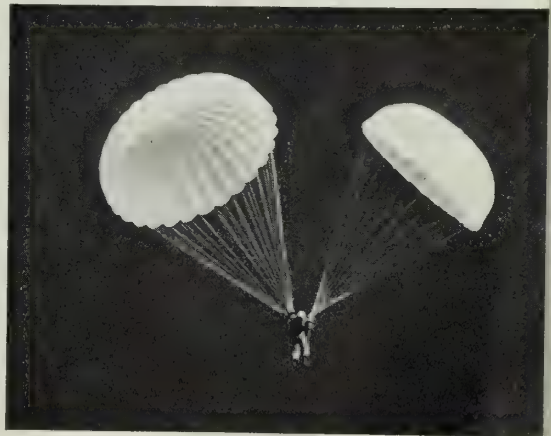
The need for these trainees is evident when the test program for any given 'chute is explained. These people don't just try out a 'chute ten times or so and then label it okay. They keep jumping it, first with dummies and then with live jumps, till they have at least 1,000 live jumps on it. After the 'chute has a thousand successful jumps on the log they admit it may be acceptable for service use.

Most of the land jumps are made in a desert target area about ten miles from El Centro while the water leaps are made in the Salton Sea. On any given day the jumps may cover a wide variety of tests ranging from trying new 'chutes and harnesses to checking a canopy quick release or a quarter bag over the skirt to slow the opening time. Most jumps are made at 3,000 feet, though some employ long free falls, and others are made below 1,200 feet.

During the test jump mentioned above, eight other men jumped as well as the drift jumper and the two testing the life raft. Several were men getting experience as jumpers, three were making their first jump and two others jumped wearing immersion suits. As with every other test jump, movies and stills were taken of all phases of the jump, from the time the men left the plane until they hit the water. These pictures are analyzed and often come up with some facts in variance with the jumper's reports. A jumper may feel sure that he was facing downward or in any other direction when the 'chute opened only to have the movies prove beyond a doubt that he was in a completely opposite position when the canopy popped open.

When the regular test men hit the ground, there are always plenty of witnesses available This is because the old pros who can't maintain balance after hitting the sand must furnish liquid refreshments for the rest

**Jumper has popped his second chute during descent as a safety measure.**



of the jumpers. Needless to say this is not a practice recommended for the average airman making a necessitated bailout. Another point of pride with the professional test boys is that they hit the 100-foot white bullseye inscribed on the desert floor.

Experienced jumpers say that no two jumps are ever alike. One test of a 'chute may show little opening shock and a rate of descent that allows the jumper to touch down and walk away with no more trouble than stepping off a high curb. Wind shifts and temperature changes a short time later may cause the same man jumping the same parachute to experience opening shock severe enough to cause brush burns on the arms or let him hit hard enough to knock the wind out of him as effectively as a punch to the solar plexus.

Birdseye view of a multiple test jump. Shown here are three opening phases of guide surface chute.

## Dummy Drops

All new parachutes are subjected to stringent tests, some of them designed to destroy the 'chutes. Many tests are made using 200-pound, rubber covered dummies shaped like the human torso. When a dummy is dropped, a telemetering set is fastened into the neck of the torso. This set transmits on seven channels to technicians on the ground who interpret the data to show exactly what happens as the 'chute comes down. This data includes such information as what G forces the dummy is subjected to in opening shock, measure tension on the risers, time required for 'chute to open, duration of G forces on the dummy, and rate of descent.

An interesting facet of the program is the research in G forces. While the human body can withstand 100 G for a fractional part of a second, it can not sustain much lower forces for any appreciable time. Experiments now under way to reduce the opening time and consequently the initial G shock are being conducted in extended skirt 'chutes, chain enclosed packs and quarter bags.

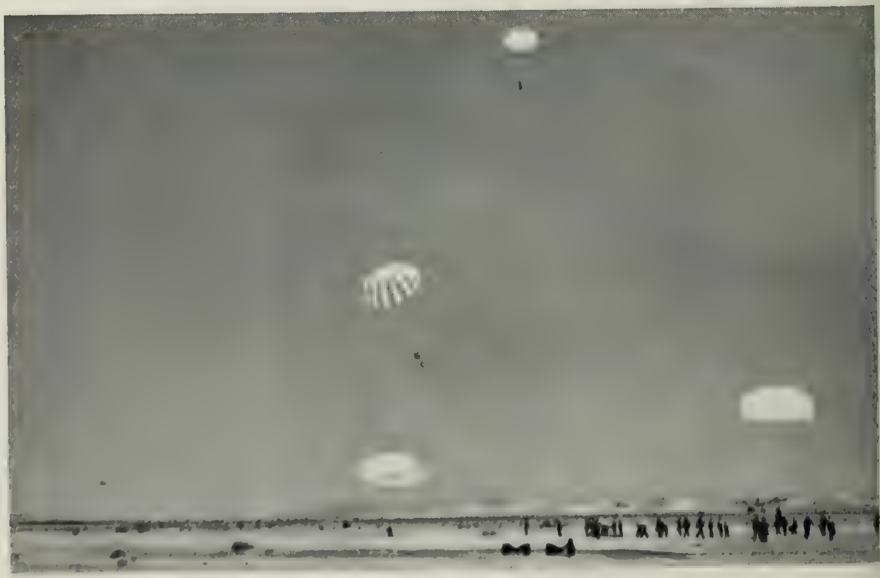
The extended skirt 'chute means that the 'chute has a smaller overall opening and that the canopy extends down farther than most present 'chutes. It definitely cuts down initial shock when the 'chute opens and has been dropped successfully from low and high altitudes. The main obstacle in this 'chute is that the shroud lines won't untangle if they are twisted. Until this difficulty is ironed out the 'chute can't be accepted.

The chain enclosed pack incorporates a zipper in place of the old ripcord cable with locking pins and cones which held the cover on a 'chute. The zipper can be freed by disengaging one pin which is attached to a ripcord cable and steel springs built into the pack cover then throw it off the 'chute faster than the old method.

The quarter bag restricts the skirt of the chute until the lines and canopy are fully stretched and, in effect, prevents whip-cracking tendencies when the chute opens.

The Air Force also operates two other devices used to test parachutes at high speeds. One, the whirl tower, rotates an arm and a cable-suspended gondola at subsonic speeds and then releases a dummy. The parachute opens as the dummy is released and lands in the desert. Various 'chutes are tested for their ability to take high speed openings such as they would have after ejection from jets.

Recovery crew, technicians and cameramen stand by to pick up a test team completing a jump over the desert area.



A specially equipped B-26, with an ejection seat in the fuselage, behind the trailing edge of the wings is used for live ejection tests along with T-33's. This phase of the test program also tests 'chutes used to slow down ejection seats, ejection capsules and special 'chutes for drones and guided missiles.

### Airborne Equipment

Not all of the work of the units is connected with personnel 'chutes. Experiments are also concerned with cargo drops and the proper 'chutes needed to drop the tremendous variety of airborne equipment now being used by the armed forces. Tiny 'chutes have been developed that can deliver a canteen or a survival kit to a stranded pilot and huge canopies have been used to lower safely heavy equipment.

Another outgrowth of the unit activity is the organization of an airborne rescue team. This team is used whenever a plane is down in the desert. Four test jumpers and two specially trained medics headed by the Navy's Warrant Officer L. T. Vinson are available in any emergency where a pilot is down.

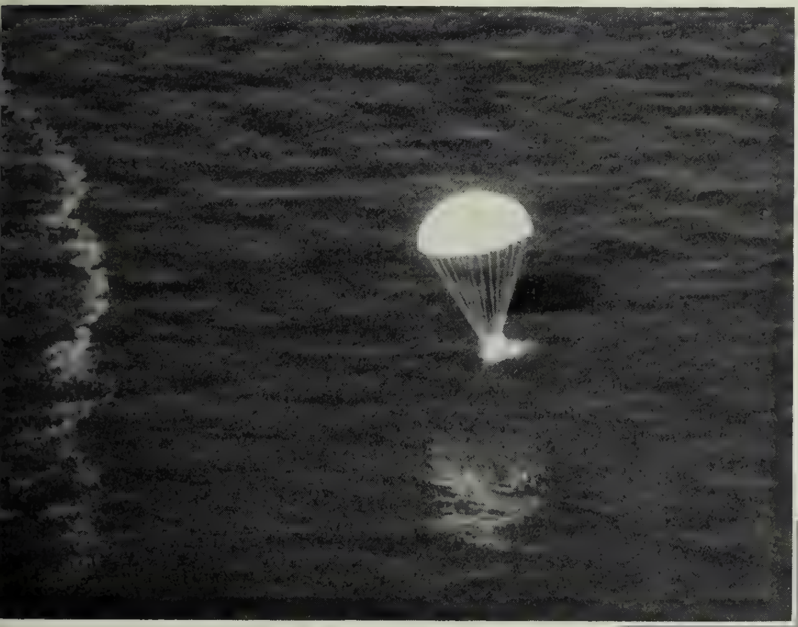
For the Air Force, the four chief jumpers or old pros are Warrant Officers Lawrence Lambert, Mitchell B. Kanowski, and Victor A. James, and S/Sgt. Walter T. White. For the Navy the head men are Warrant Officer L. T. Vinson, official jumpmaster of the base, and PR1 Clarence E. Stedham.

Lambert, Kanowski and Vinson, in an informal discussion, came up with some bailout procedures that can be of great value to the average pilot or passenger in USAF aircraft. The three are well qualified to pass out the straight poop on bailouts as they have over 500 jumps between them! Vinson with 336, Lambert and Kanowski with over 100 jumps apiece.

### Bailout Tips

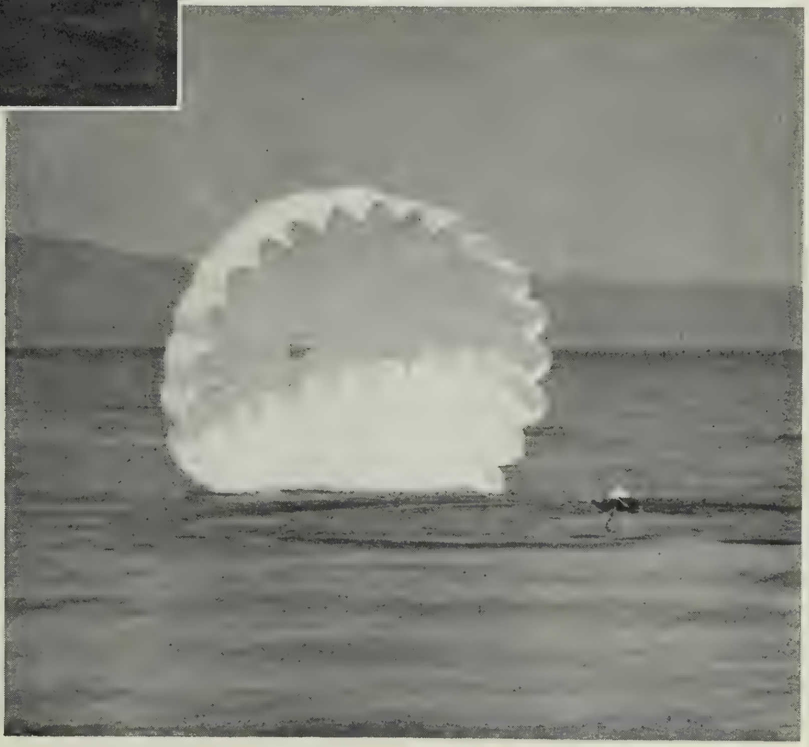
When getting out of an aircraft, use your hands to expedite and assist your exit from the plane, don't keep your hand on the ripcord. Lower the head and get the chin on the chest. This keeps the face and head out of the way of the risers as the 'chute opens and ensures that the jumper will be looking at the ripcord handle. If the ripcord is in view there will be no unnecessary clawing at the harness when ready to pull the ripcord. Legs are kept together to prevent the line from passing between the legs during 'chute opening. Depending on altitude, count about three seconds before pulling. If at low altitudes it may be necessary to pull early and if

**Hitting the drink during tests made on new back pack life rafts.**



**The first man goes out a split-second after the jumpmaster gives the signal.**

**Jumper collapses chute and prepares to get out of harness after landing.**



at high altitudes it is advisable to free fall down to at least 15,000 feet to avoid freezing or anoxia. El Centro jumpers count to three by saying one thousand, two thousand, three thousand.

The trio stated that when getting out of a cargo type aircraft with large doors the best method is to place both hands on the door frame and push off vigorously with the left foot. After pushing off with the left foot, try and swing the right foot out to execute a quarter turn which places the back to the slip stream. Then put head down and keep feet together and arms at the sides until ready to pull the ripcord.

When getting out of a plane with side hatches grasp the sides and catapult out in a rolling motion.

If using a bomb bay or bottom hatch roll out facing forward. This gives the jumper a rolling motion away from the plane.

When bailing out of a fighter or trainer not equipped with ejection seats, jump toward the trailing edge of the wing.

In every case, once clear of the plane keep feet together and elbows at sides to prevent somersaulting and try and open the 'chute when vertical.

On a 'chute with the D-ring on the left side of the pack they use this procedure. As stated previously, keep the head down with the chin on the chest, hook the left thumb under the ring and lift it clear of the body. Then grasp it with the right hand and pull it away from the body. Finally, using *both* hands vigorously pull the ring out and away.

### Slipping a Chute

Much has been said at various times about slipping a 'chute but the men who ought to know say that it is an extremely difficult operation to perform for any length of time. A strong man may be able to slip a 'chute for 30 seconds or so but it is very tiring and should be used only when absolutely necessary.

To slip a 'chute pull down on two risers on the same side in the direction you wish to slip. Primarily, slipping should be used to avoid an obstacle such as wires, trees, buildings or bodies of water. Always slip to land short of the obstacle; don't try to get over it if there is a doubt as to clearance.

Try to land with the wind quartering 30 to 40 degrees at the back. This offset to the wind insures a roll on to the padded areas of the body upon landing.

One of the most important parts of a jump is the touchdown. The big thing to remember when about to hit is *to relax.* When approaching the ground, look out at a 45-degree angle, never down at the ground. Veteran jumpers claim that it is impossible to judge height when descending in a 'chute, and say most people get hurt by misjudging distance and trying to brace for impact.

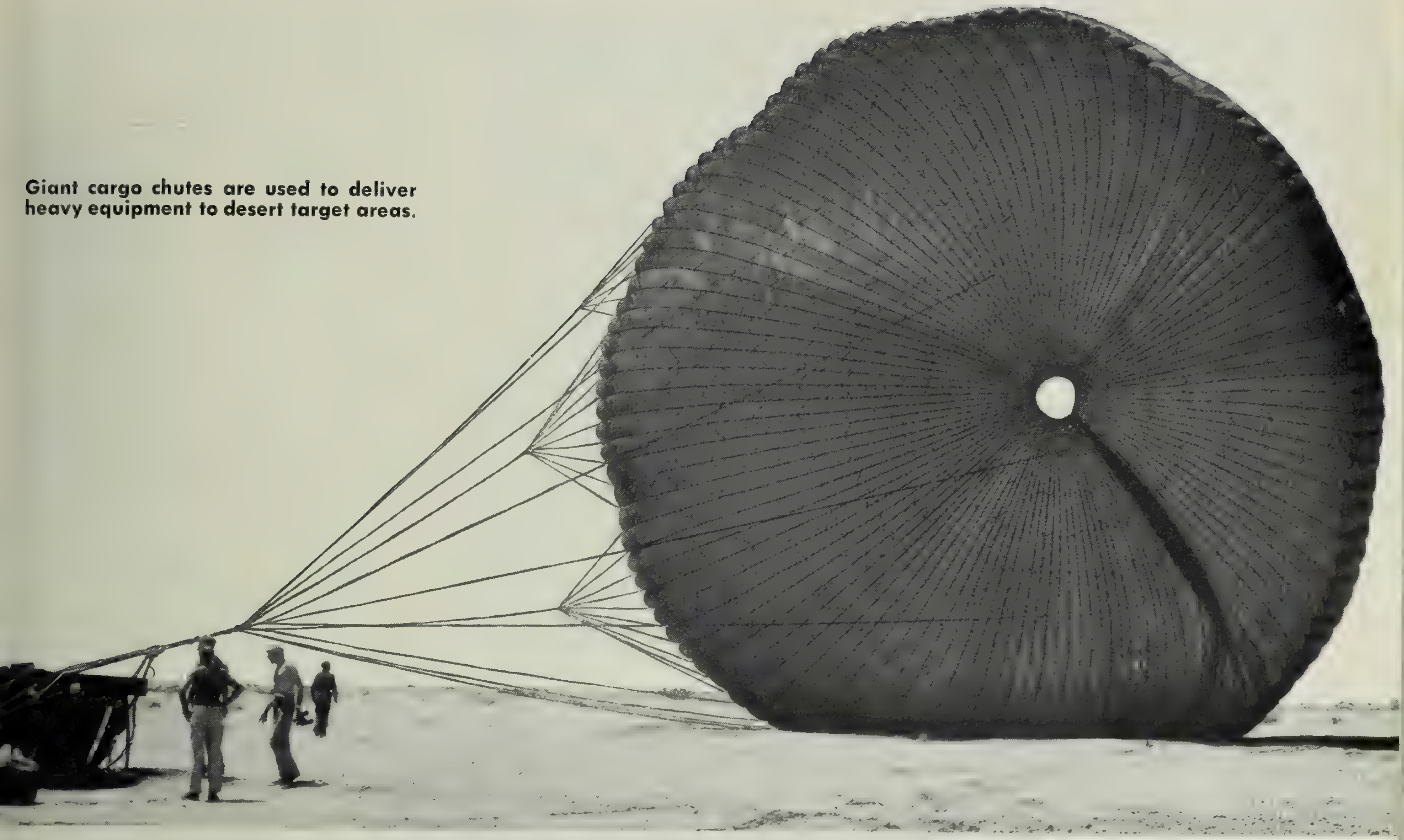
A jumper should try to hit on the balls of the feet and then crumple up and allow the body to sag to the ground, "Like a big, wet dishrag," according to Lambert. "Keep the feet no more than six inches apart and relax, you'll hit soon enough without straining for the ground," Vinson added.

When nearing the ground the big DON'T to remember is not to try and break the fall with either hands or feet. The two big faults of most jumpers are "reaching" and "handstanding." "Reachers" are those who stretch out one foot feeling for the ground and land with one leg rigidly extended. This usually results in a bad sprain or a break. "Handstand-

**Less than a minute after landing the jumper paddles his life raft to the boat.**

**Test jump chutes are carefully inspected and checked before being packed by Air Force and Navy technicians.**

**Giant cargo chutes are used to deliver heavy equipment to desert target areas.**



ing" consists of landing on the feet and then trying to break the fall with both arms extended down. This system is almost guaranteed to break something.

If being dragged, pull all the lines on one lower riser toward you; this will collapse the canopy. Remember—the new Class 3 harness has quick releases which disengage the canopy and prevent dragging.

### Water Jumps

If the jump takes place over water it is more important to be prepared to get out of the 'chute upon contact. Get into the saddle or harness seat, grasp the harness at the right shoulder with the left hand and unbuckle the harness snaps with the right hand. The left arm across the body holds the jumper in the seat till all buckles are unsnapped after which the arms should be crossed and opposite sides of the harness grasped. Immediately after hitting the water throw arms over head and stiffen legs to disengage the harness and then inflate the mae west. This technique can also be of use when jumping over lands in high winds. Don't start to disengage the harness until you think you are between 300 to 500 feet.

If a tree landing is unavoidable, cross ankles, point toes down and keep legs together. Turn the face to one side and shield with arms. If any aid is possibly near, stay where you are till it arrives. Nothing is easier than falling out of a tree after making a successful jump.

A final word from the experts concerned clothing. Dress for the country you'll be operating over because if you do have to get out of an airplane things may get pretty rough before you're picked up, if you're not prepared. Be especially careful in your choice of shoes. High shoes not only prevent injuries when hitting the ground but are far better for walking after you're down. And walking is one occupation where it's better with the shoes on.

☆ *Don't forget to check your 'chute while you are still on the ground.*

☆ *Don't forget to check the fit of the 'chute. If you don't know how, ask the pilot.*

☆ *Don't carry it wrong. Carry and wear it the correct way.*

☆ *Don't use it for a stepping stone. Don't kneel or step on it.*

☆ *Don't get your 'chute wet. Protect it from oil, grease and water.*

☆ *Don't throw your 'chute on the ground. Treat it gently, lay it with the pack up.*

☆ *Don't forget your high altitude bailout procedure.*

☆ *Don't forget to fasten your bailout bottle and life raft to your person securely.*

☆ *Don't give the pilot an argument when he tells you to go. JUST GO.*

☆ *Don't leave the plane with your ripcord in your hand.*

# OXYGEN
# STAY CONSCIOUS

### By Maj. James A. Jimenez, USAF, Directorate of Flight Safety Research

**Oxygen is required to keep *our* engine running. Oxygen starvation is much like fuel starvation. Without it a state of emergency soon exists.**

EVEN fish gotta have oxygen. Nature has equipped them with a little gismo that extracts the oxygen out of water, and they can go tooling along the finny deep indefinitely . . . until they strike a bright lure. High up in the blue the only source of oxygen is your aircraft oxygen system. Without this hand equipment all sorts of crazy things happen. And you don't have to be cruising at 25,000 feet in order to see spots before your eyes . . . you can go ga-ga at altitudes of lesser magnitude.

Here's how it works out. We are all agreed that the best method of reaching your destination is by the continued use of the old noggin. In order for this appendage to function normally, it must have oxygen. When the pilot receives insufficient oxygen, the brain malfunctions and a state of emergency exists.

Your gray matter contains what it takes to increase the ability to control and coordinate processing of intelligence matters and higher functions of your body. Herein lies your conscious ability to think—the main teletype office which is the headquarters for the processing, cross-indexing and filing of all incoming messages. It also evaluates and approves all outgoing messages.

According to the medical men, the cells in the brain are the most active cells in our body. They require more food and more oxygen than any others. They don't carry a "reserve" supply of food or oxygen, and therefore are immediately impaired when the body suffers a lack of oxygen or energy food. A restriction in amount of oxygen flow to this section of the body causes various malfunctions in the brain which, in turn, produce such outward symptoms as poor coordination, mental aberrations, misinterpretation of audio and visual signals, increased emotional instability, personality changes and many other changes which might affect one individual more than another.

### Comparison

Dependent upon the amount of oxygen restriction to the brain and the bodily physical condition of the individual, a severe impairment to the brain can be compared to the confusion that would result in the main teletype office if someone threw all the "immediate priority" messages into the air and kicked all the "in" baskets onto the floor.

The above layman's version leads us into a serious discussion of the importance of oxygen to the pilot in flight.

Paragraph 19 of Air Force Regulation 60-16 says:

"19. *Use of Oxygen.* Crewmembers will use oxygen when the cabin pressure altitude is 10,000 feet or above. Exceptions to the foregoing

Under high pressures in the altitude chamber these men learn about the use of oxygen.

may be made for *aircraft not normally equipped with oxygen,* only when ascent to higher altitude is necessary to clear high terrain, provided that the altitude is not maintained for more than one hour. Crewmembers will be encouraged to use oxygen on prolonged flights when cabin pressure is over 8,000 feet; passengers, when the cabin pressure altitude is above 10,000 feet. In no case will an aircraft be flown above 14,000 feet without oxygen."

This paragraph has been very widely misinterpreted by the pilot. The last sentence, "In no case will an aircraft be flown above 14,000 feet without oxygen," has undoubtedly caused many a pilot, indirectly, to remember 14,000 feet as the maximum altitude to fly without oxygen.

In many organizations, perhaps in your own, you'll find pilots who won't hesitate to fly at altitudes above 10,000 and below 14,000 without oxygen. A general feeling of complacency has resulted over the years about oxygen use in the "danger zone," 10,000 to 14,000 feet. This complacency has arisen due to logistics problems in some organizations and due, in great part, to the ignorance of pilots and Ops officers in the dangers of flight without oxygen.

The greatest contributing factor to this ignorance is the fact that very few pilots who have been physically impaired by lack of oxygen have realized it! The most dangerous effect of oxygen-want is that the affected pilot is lulled into a false sense of well-being—a mental aberration such as might be compared to that of a person heavily loaded with an intoxicating alcoholic beverage. He feels "extremely well" and doesn't have the slightest idea that his judgment is off or that his coordination is affected. In extreme cases of oxygen-want, *he suffers from lack of memory,* his reasoning processes slow to zero, and if the truth were known, "he couldn't hit the ground with his hat!"

### Not Humorous

Humorous as they may seem, the described effects are pathetically and dangerously true. Any flight surgeon will attest to their validity and add a few more thousand words about the subject which will make your hair stand on end.

He might add that though there are definitely defined stages of "hypoxic hypoxia," a person's tolerance to hypoxic conditions may vary from day to day, according to his physical and mental condition at the time that he suffers from oxygen-want.

Two pilots, for example, sitting in the same cockpit, might exhibit entirely opposite reactions at high altitudes without oxygen. Individual variation in the ability to withstand hypoxia is considerable and accounts for variations in "ceilings." Physical fitness and acclimatization from residence at high altitude raise an individual's "ceiling," while apprehension and lack of adequate physiological compensation by the respiratory and circulatory systems lower it.

Inexperienced personnel collapse more frequently at intermediate altitudes than do experienced individuals. In this case, the factor involved is psychogenic. In other words, anxiety caused by a feeling of incapability would, in turn, reduce a pilot's ability to resist the effects of oxygen-want.

In an accident involving a C-47, a check of the pilot's IFR clearance disclosed that he had flown for approximately two hours and eight minutes at 10,000 feet on the last leg of his cross-country flight. In his last radio contact, the pilot stated that he was at 13,000 feet. With the time of the accident being fairly well established within five or ten minutes, it can be reasonably ascertained that he flew at 13,000 feet for twenty or twenty-five minutes. Severe turbulence and up and down-drafts in this area may have forced him from 13,000 feet down to 9,000 where he struck a mountain, or he may have erred in

**Set for a high altitude mission, this pilot is ready to go on oxygen anytime.**

**Effective range of pressure-demand equipment is limited, but it may be used safely up to about 42,000 feet altitude.**

judgment by descending prematurely to that level.

There are a number of other factors to consider, and the final report is not yet written, however, one other question must be considered. Was this pilot affected by lack of oxygen? No one can positively state that he was affected by lack of oxygen, but the possibility exists. Another very good factor to consider is that if suitable oxygen equipment had been available aboard the aircraft, the pilot might have elected to fly at a higher altitude above the mountains.

In another C-47 accident, the pilot was briefed on severe icing at 12,000 feet, but requested and received that altitude on an IFR clearance. The wreckage of this aircraft was later found at an elevation of 10,500 feet MSL on a mountainside. According to the pilot's last radio contacts, the accident occurred three hours and thirty minutes after the pilot received his IFR clearance.

Three hours and thirty minutes without oxygen at 12,000 feet—severe icing. There was no oxygen available in the aircraft. What could have prompted this pilot to fly at the minimum en route altitude on that airways when he had been briefed on severe icing at 12,000 feet? Obviously, the best altitude was on top at about 16,000 feet—with oxygen.

On this same day within a twelve-hour period, six other aircraft with oxygen aboard flew along this same airways at altitudes from 17,000 to 20,000 feet. They were on top of the overcast and encountered no difficulty. What effect do you think oxygen would have had on this flight? Would *you* have cleared at 12,000 feet in severe icing conditions if you had suitable oxygen equipment aboard? Would you, as clearing authority, have cleared this flight without oxygen?

Another pilot filed IFR over a mountainous route in December, 1951. The wreckage of his C-47 was located the following May on a mountain peak along the route. Heavy, clear icing was reported on the day of the flight between 6,000 and 12,000 feet. This pilot, without oxygen, was flying IFR at 10,000 feet, the minimum en route altitude on airways. He was considered a very experienced pilot by his organization, having a total of approximately 5,400 hours flying time of which almost 3,000 were in C-47's. What prompted him to fly at 10,000 feet in heavy icing, with strong crosswinds on an airways adjacent to a mountain peak which was 10,466 feet high? Do you think that he would have flown at a higher altitude if there had been suitable oxygen equipment aboard?

It is our opinion that many Air Force pilots today are requesting minimum en route altitudes on airways during IFR conditions solely because of lack of oxygen or oxygen equipment aboard the aircraft. It is also true, we believe, that many who won't accept the minimum altitude en route are flying at higher altitudes between 10,000 to 14,000 feet without oxygen. This practice, if continued, can mean sudden death to many more pilots. Therefore, it is important that suitable oxygen equipment and an adequate oxygen supply are maintained at all bases at all times.

Until this is done Air Force-wide, it would be well for all clearing authorities to read paragraph 19, Air Force Regulation 60-16, before okaying a clearance on an outbound aircraft.

Paragraph 42, AFR 60-16, says: "42. Restrictions on and Responsibility of Clearing Authority:

"a. *Requirements and Regulations.*

"The clearing authority will assure that the proposed flight is to be conducted under proper flight rules, that all applicable flight requirements and regulations are complied with, and that the aircraft is suitable and the pilot is qualified for the type of flight contemplated.

"*NOTE:* Every effort will be made by operations officers and Flight Service centers to advise all pilots of any deficiencies in their flight plans."

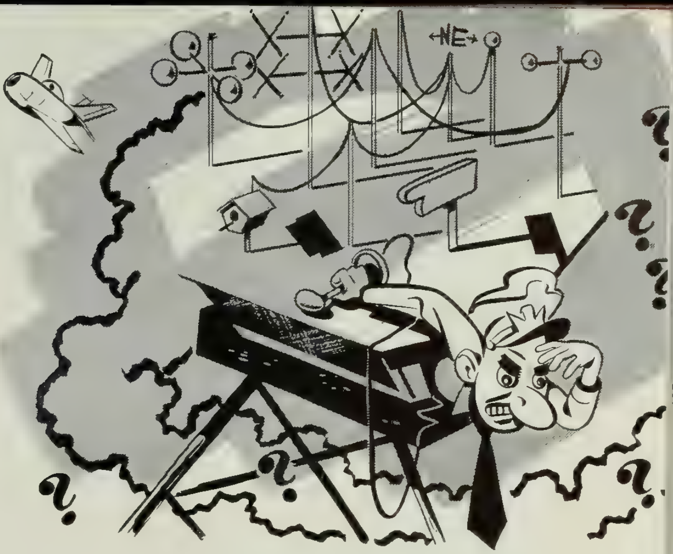
The responsibility for checking your oxygen supply, oxygen masks, and the operation of the oxygen system rests with you, as the pilot of the aircraft. In the first place, you never know when you may need that extra oxygen boost. What may start out as a few turns around the local area may end up as A1 on the Form One, and you may need that $O_2$ to keep your mind alert and your eyes sharp. Second, you may feel that your cross-country flight won't take you above non-oxygen levels . . . but it *might.* Third, you may be one of those superman types who knows he can fly for hours above 8,000 feet and feel fine . . . but the ordinary man *can't.* Oxygen is supplied free by the United States Air Force. Doesn't cost you a cent . . . in fact it's the cheapest insurance a man can have.

## oxygen at altitude

There are two ways in which to maintain an adequate oxygen intake at high altitude. One is by means of a pressurized cabin or a pressurized suit, which will provide a relatively high gas pressure both inside and outside the body. The other is by means of a pressure-demand oxygen system, which supplies oxygen to the lungs at a pressure slightly higher than that outside the body. Because the body can stand only a limited amount of internal pressure, the effective range of pressure-demand equipment is also limited. It may be used safely up to about 12.000 feet. and for emergency purposes up to 45,000 feet. In pressurized aircraft, pressure-demand equipment may be used up to 50,000 feet for very short periods.

The new D-1 regulator which is in use in a few airplanes is designed for use at altitudes up to 50,000 feet. It supplies a sufficient amount of oxygen at all altitudes up to 40.000 feet but from 40.000 to 50,000 makes a compromise on the amount of oxygen supplied between that which is necessary and physiologically endurable pressures involved. Were the proper pressure of oxygen delivered to the mask at altitudes above 40.000 feet. it would be extremely difficult to breathe under the necessary pressure; therefore the D-1 regulator is actually designed for limited emergency use only. between 40,000 and 50.000 feet. The D-1 regulator is fully automatic. ●

# button.....
# button.....
# *who's got the* BUTTON?



AN OLD YUK, bruited about nurseries for the past several decades, makes capital of the fact that a horse-shoe nail, causing a courier to shed a shoe, can lose a battle, y'know!

This boffola, which undoubtedly kept the kiddies in stitches in the pre-space cadet era, points a moral that can be dove-tailed into the modern flying pattern . . . for the lack of a mike button check, a flying machine can be lost, including one each crew, to boot.

A tiny thing like a mike button, or an open key, inconsequential as it may seem, when multiplied by many examples of carelessness throughout the Air Force, can cause a great organization like AACS, to literally throw up its collective hands, and tell FLYING SAFETY, "please, maybe you can spread the word, and tell the troops what's happening every day on this subject."

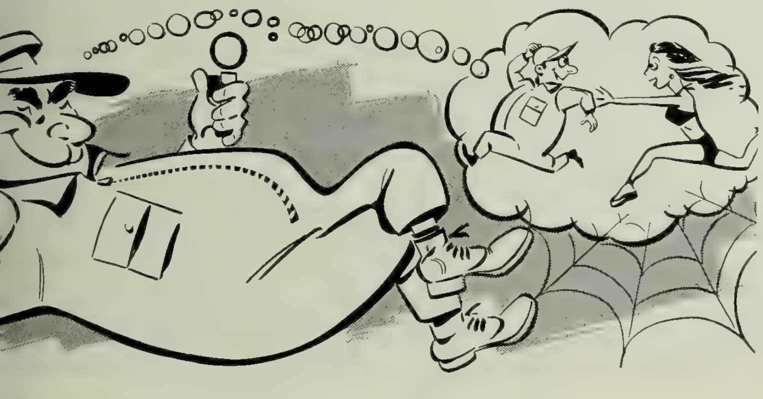
Hardly a day goes by, they say, when a radio operator in the process of testing a set, will leave the mike keyed and the equipment on while he dashes over for a cup of coffee. He should know, as well as he knows his own name, that this open key can block out completely all transmissions on the local control tower's primary frequency. This, coupled with the possibility of a power failure or an equipment failure on the tower's secondary frequency, can set the stage for a fatal accident.

### Light Gun Signals

When the two tower frequencies are out, light gun signals are the only remaining method of communication, and it is conjecture as to how many pilots are familiar with the various aldis lamp signals. For instance, do you know that light gun signals can be used only to approve or disapprove an action the controller *believes* the pilot of an aircraft *intends* to perform? Do you know that a light gun can be used only to send a general warning signal, but cannot explain the nature of the emergency? Put yourself in the controller's place, and imagine the confusion that would reign, if you had to work airplanes in the pattern, airplanes taxiing and vehicular traffic, with a vocabulary of "Yes," "No," and "Careful." A glamor gal can get along pretty well with these three words; but a control tower operator, definitely negative!

### Hard to Find

Locating an aircraft with a stuck mike is in itesl a chore. Every airplane on the ramp has to be inspected. If no aircraft radio is on, then the maintenance and repair hangars must be checked. Naturally this takes time, and every moment of enforced silence on a radio channel multiplies the possibility of an accident. Now let us look at the problem from the standpoint of the pilot in the air. Cruising at 35,000 feet; fat, dumb and sublimely happy, is one each jet jockey. He calls Alpha Tower to get local weather. He likes the forecast and decides to mill around for another thirty minutes. This works out fine, and everybody is happy except the tower operator. Roger the Lodger has left his mike button stuck in down (on) position, and has put every tower within the area on the air on 126.18 kc. This happy soul will continue to cause this kilocycle blackout until he decides to use his mike again, or until someone, in sheer desperation, homes in on his frequency and gives him The Word.



Now you purists among our readers (and we have hundreds of eagle-eyed subscribers) will say that the odds are high against all tower frequencies being out . . . so high that there is negative perspiration. It doesn't work out this way. Many airplanes carry only the primary frequency, and no other common tower frequency. Some carry the emergency frequency found in all towers. But there is the possibility that two pilots can be blocking two different tower frequencies at the same time. It's in the record that there have been times when four frequencies have been blocked simultaneously.

It is realized that spelling out these abuses won't eliminate the blocked frequency hazard. The solution to the problem lies with you who fly the airplanes. Make it a habit to check your key and check your mike after every transmission. Don't be a frequency hog . . . remember, someone else may want to get in on the party line! ●

# Cross Feed

## flying safety idea exchange

### Proper Altitudes

I feel that the rules for proper altitudes covered in AFR 60-16, which are shown on the back cover of the November issue of Flying Safety, are correct, but are not as complete as they might be, and that special emphasis should be placed upon the correct altitude under VFR conditions.

The results of a survey conducted on our base revealed that approximately 50 per cent of the pilots and students didn't realize that they are required to maintain definite altitudes while flying VFR in control zones and/or control areas (airways).

Our Flying Safety department has initiated a program with the intentions of familiarizing all pilots with the regulations concerning proper altitudes. We have constructed charts using information obtained from CAA Flight Information Manual, CAR 60.32, AFR 60-16, and ATRC 60-10. This chart makes clear the various altitude requirements of the CAA.

**Capt. Robert C. Shaw**
**Flying Safety Officer**
**3500th Pilot Trng Wg**

### Jato for B-29's

A B-29 accident occurred in North Africa recently which was caused by engine failure either during or immediately after takeoff. Apparently the pilot was unable to gain altitude so he attempted a crash landing straight ahead. However, in doing so, the aircraft struck a small concrete building, cartwheeled, and exploded. The loss was complete.

This accident is typical of other fatal B-29 accidents which have occurred under similar circumstances.

It is felt that the installation of six or eight JATO units on all B-29 aircraft, which could be used immediately in event of engine failure during takeoff, would furnish the required thrust for the pilot to recover from a very critical condition. It might be possible to install retractable JATO units which could be extended prior to all takeoffs and possibly for all two- or three-engine approaches just in case a go-around is necessary.

It is felt that the cost of installation of JATO units in all remaining B-29 aircraft would be very nominal in comparison to the loss of even one plane and crew.

**Maj. Bernard B. Pasero**
**O&T Inspector**
**Hq 7th Air Div**
**APO 125, NY, NY.**

### Is You or Isn't You

If crystal balls really worked, there might be some justification for the blythe disregard of proper parachute discipline on the part of far too many airmen. Those characters who never wear or dump their harness right after takeoff are just the ones who end up on USAF Aircraft Accident Reports. Some of the jet jockeys who still have Class I or Class II harnesses without the new leg strap take-up hardware, fall into the same category. They pop the leg straps for comfort and leave them unsnapped.

Knowing that survival time — not often minutes, more often seconds— is always cut down more quickly than the aircraft disintegrates, these people are paying the limit for their dubious "old timer" exhibitionism.

**Major Harold L. Strong**

### First Epistle to Pilots

*Check thou the scriptures called Notam, Radio Facility Chart and Airman's Guide. The wise pilot in planning his flight overlooketh nothing; only a fool sticketh out his neck.*

*Use thy checklist. He that useth it*
*not is vain and foolish;*
*He would fain become an old pilot*
*but he is not qualified.*

*Beware thou the high mountain along*
*thy route of flight;*
*It is exceedingly hard and smasheth*
*to smithereens the unwary.*

*Verily I say unto you, the pilots'*
*heaven filleth up*
*With those who practice not their instrument flying.*

*Lo! and it came to pass that the pilot*
*sayeth unto his engineer:*
*"You keep the fans turning while I*
*watch the railroad track."*

*Verily I say this leadeth to more work*
*for the Chaplain*
*And collection of thy insurance. Take*
*thy flying seriously.*

*Sit not on thy posterior and bore*
*holes in the air.*
*Use every opportunity to improve thy*
*technique.*

**Major George E. Tormoen**

From the instructor's point of view there is unlimited visibility with the new shutter hood developed by Lt. Col. L. J. Mercure and Capt. A. H. Francis.

# WELL DONE!

***The failure to comply with T. O. 01-5EUB-103 (Red Border) dated 8 January 1951 nearly caused a major aircraft accident. The left inboard aileron trim push-pull rod which sheared during flight dropped down and wedged itself into the leading edge of the left aileron trim. The aircraft became practically uncontrollable and required superior flying skill plus the combined physical force of both pilots applied to aileron and rudder to prevent a crash.***

MAJOR MARCHESE AND LT. GEMMELL, FLYING AN RB-36, WERE MAKING A GCA INTO CARSWELL...SUDDENLY WHEN ON BASE LEG, THE PLANE LURCHED TO THE RIGHT AND BEGAN TO DESCEND....400 FEET WAS QUICKLY LOST......

THE COMBINED EFFORTS OF MARCHESE AND GEMMELL PLUS FULL LEFT RUDDER TRIM RETURNED THE PLANE TO STRAIGHT AND LEVEL FLIGHT....GEAR WAS RETRACTED AND FLAPS RESET...MANIFOLD PRESSURE WAS REDUCED ON ENGINES ONE AND TWO....ALTITUDE WAS REGAINED AND COCKPIT CHECKED FOR CAUSES.....

.....REDUCTION OF POWER HAD NO EFFECT ON THE ROLL TENDENCY, AND DIRECTIONAL CONTROL COULD ONLY BE MAINTAINED WITH THE COMBINED STRENGTH OF BOTH PILOTS....PERMISSION FOR AN EMERGENCY STRAIGHT-IN APPROACH WAS GRANTED.......

THE THROTTLES WERE USED TO STEER THE AIRCRAFT.... SINCE BOTH PILOTS WERE NEAR PHYSICAL EXHAUSTION THE APPROACH WAS MADE WITH GREAT DIFFICULTY, BUT A SMOOTH LANDING AND A NORMAL STOP WAS ACCOMPLISHED ... SUPERIOR FLYING AND CLEAR THINKING MADE A REAL FLYING SAFETY COMBINATION.....WELL DONE !

# Keep Current

## NEWS AND VIEWS

• **F-51 Retracted Tail-wheel**—A possible way to meet the situation, providing the pilot knows his tail wheel is retracted, is to use the technique of keeping the tail of the F-51 off the ground as long as possible after landing so that airspeed is relatively low when the tail finally does touch down. This will reduce the magnitude of the yawing and rolling moments, due to lowered airspeed, thereby making the airplane easier to control with the brakes and decreasing the likelihood of serious damage if a ground loop does occur.

In any case, pilots may be reassured to know what causes the violent ground loop in this type of landing, since the F-51 is normally such a good airplane directionally after touchdown. *(R. D. VanDyke, Jr., Research Pilot, NACA)*

• **Rapid Receipt of Weather Info.**—Flight Safety often depends on the rapid reliable transmission of weather observations and advisories from the weather station, where they are made, to local units such as control tower and GCA, where they are used.

At several bases in ZI, this rapid transmission of reports is now accomplished by telautograph, a commercially leased telescriber device which transmits handwritten messages from one point to another over telephone lines. Rental costs, which are modest, are paid from base funds. The equipment is serviced by the owning agency, and for this reason its installation is limited to the ZI and within prescribed distances of company maintenance offices.

Air Weather Service is encouraging the use of this device by familiarizing base personnel with its advantages.

Appropriate use of this equipment is valuable for the promotion of flight safety. *(Air Weather Service)*

• **Clouds Tell of Jet Stream**—By carefully co-ordinated observation of cloud formations, weather stations across the country could establish the location and direction of the jet stream, a mysterious wind tunnel in the sky.

According to scientists, there are four "specific and rather spectacular cloud types" that are visual keys to the whereabouts of this high-speed stream that often doubles the speed of high-flying aircraft.

Field research shows that any three of the four tell-tale cloud formations, plus high cloud speeds and "coherent" patterns, may be used to determine the presence of these powerful winds.

At present it takes fairly complicated upper air soundings to locate this skein of winds that blows at speeds of from 80 to more than 200 miles an hour at altitudes of 20,000 to 50,000 feet. The stream moves at slower speeds at lower altitudes.

The four basic cloud formations are:

• Cirrus streamers, white feathery wisps with tufted trails, seen moving at high speeds and high altitudes.

• High cirrocumulus—small, white, rounded clouds in patches often scattered at random, but sometimes shifting rapidly to cirrus streamers with delicate wave patterns. They often take on tints of green and red near the sun.

• Altocumulus, fleecy, nearly stationary formations with lens-shaped clouds, piled layer upon layer at middle altitudes (about 20,000 feet). These clouds change rapidly, especially when sending snow in long streamers down wind. Such streamers are evidence of the high-speed movement of the air. Some of these formations also are tinted near the sun.

• Billowing altocumulus clouds which often extend from horizon to horizon, with parallel waves running at right angles to the direction of air flow.

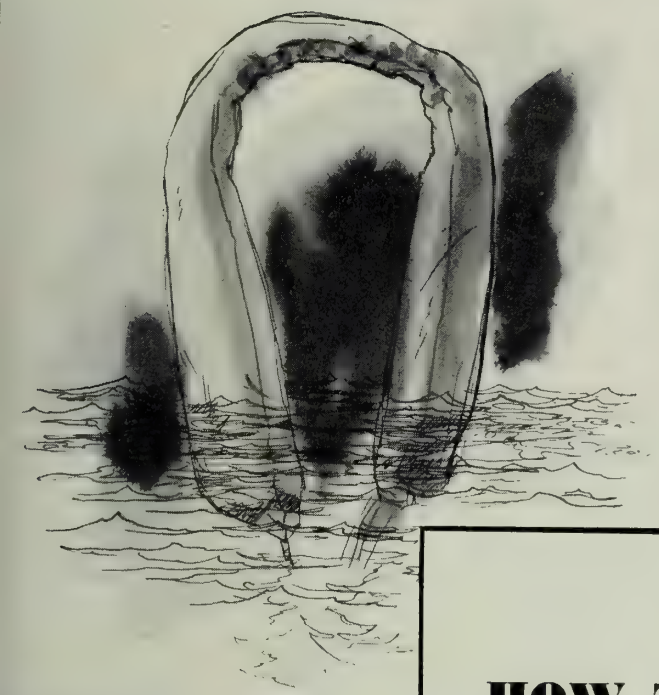
Other tell-tale signs of the proximity of the major axis of the stream include:

Gustiness at ground level in about half the cases observed; persistent cool, crisp air; generally blue skies, with visibility unlimited; precipitation often limited to "sporadic sprinkles of rain or snow," and rapid changes in cloud cover, from one-tenth of the sky to nine-tenths and back again "in less than an hour."

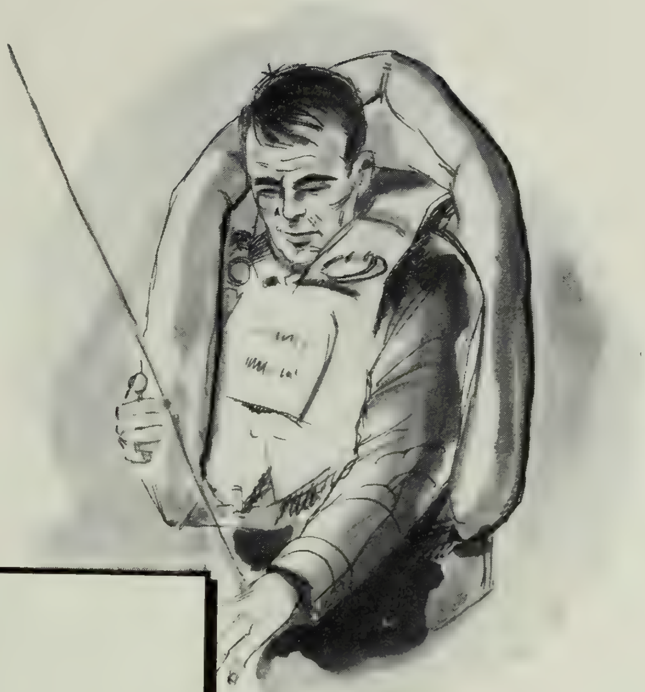
Quick identification of this phenomenon is becoming increasingly vital to aviation and also to weather forecasting. ●

What won't they think of next!

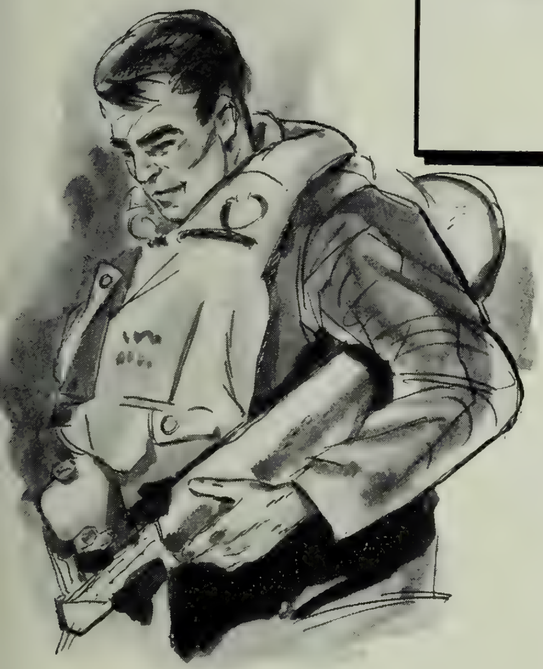
# HOW TO BE RESCUED BY A HELICOPTER



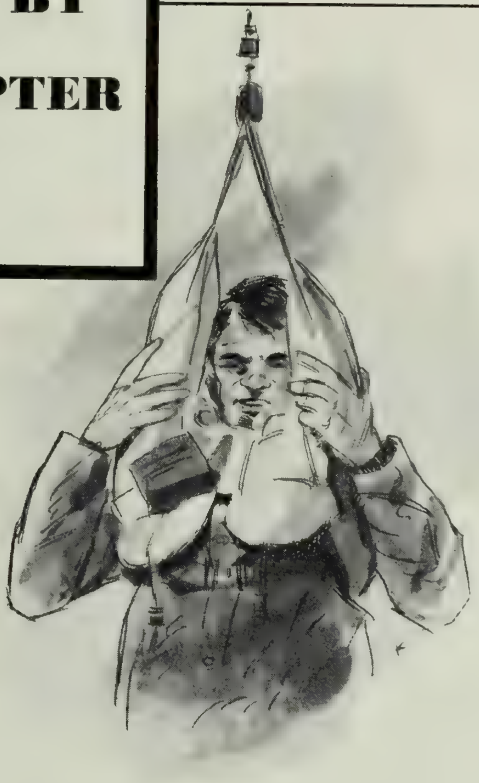
Normal position of rescue
ling in water.



Slip rescue sling over shoulder and arms.



ut both arms down over rescue sling.



Position for hoisting.

# Get in the GAME!

By sliding into third a ballplayer shows that he is making an all out effort to be safe. Be sure that you, as a member of the Air Force team, are making an equal, all out effort toward being safe.

Each year the major league ball clubs go to spring training camp for weeks of intensive practice. This practice includes everything from plain running to get the kinks out of winter-tightened legs to full scale inter-squad games and exhibitions with other clubs. Judging by this slide into third, the St. Louis Browns take their spring training seriously and are playing even their practice games for keeps. The ball players on the club, as professionals in a highly competitive field, know that it is only through practice and training that they can retain the skills needed to hold their jobs and weld themselves into a winning team.

To an Air Force pilot, practice and training are even more important. His "spring training" consists of everything from practicing manuevers and knowing procedures to learning regulations and obeying them. Without this practice and training, it is impossible to maintain the high standards of proficiency and safety needed to keep the Air Force on top as a winning team.

☆ U. S. GOVERNMENT PRINTING OFFICE 1953

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# FLYING SAFETY

UNITED STATES AIR FORCE

MAY 1953

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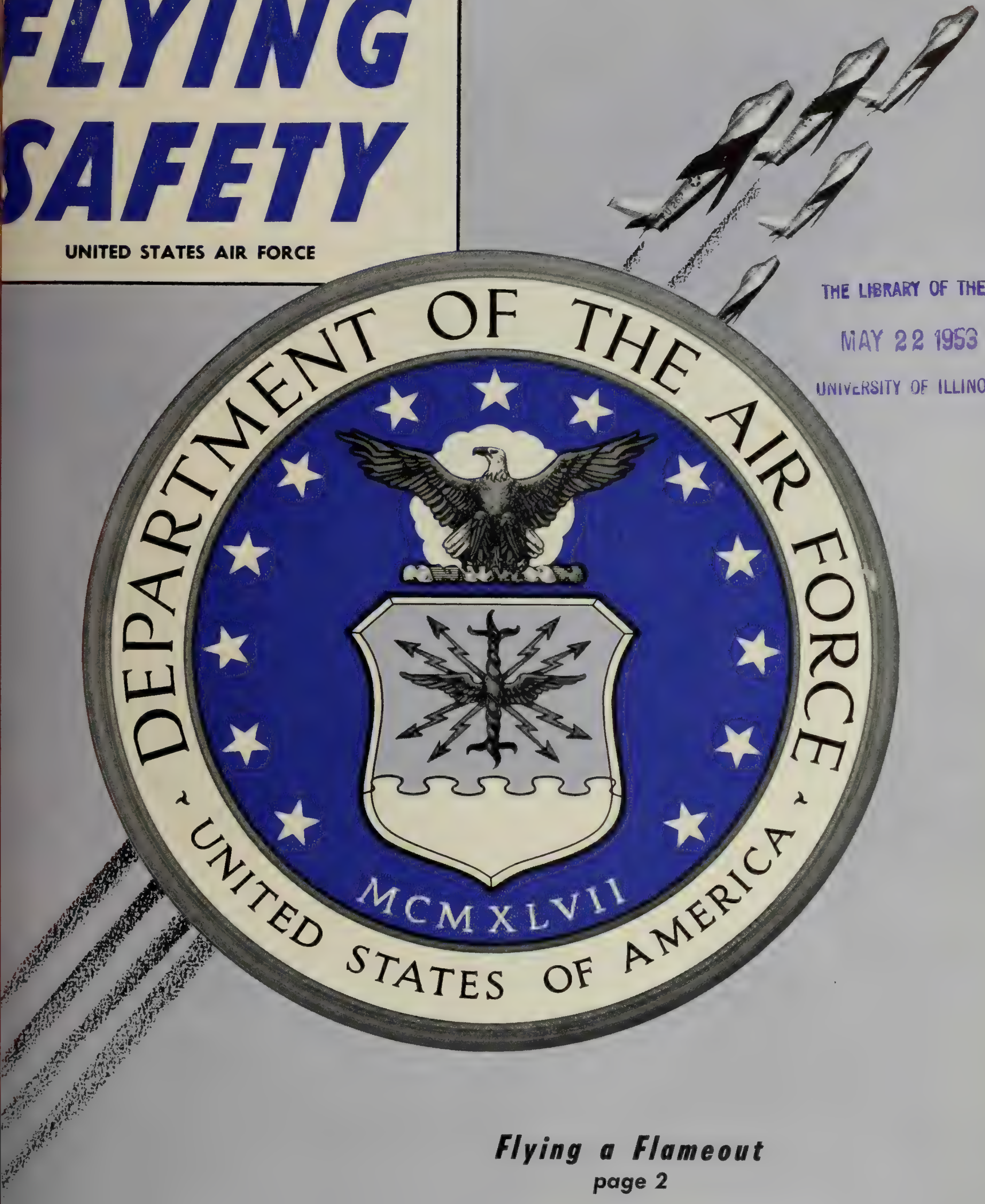
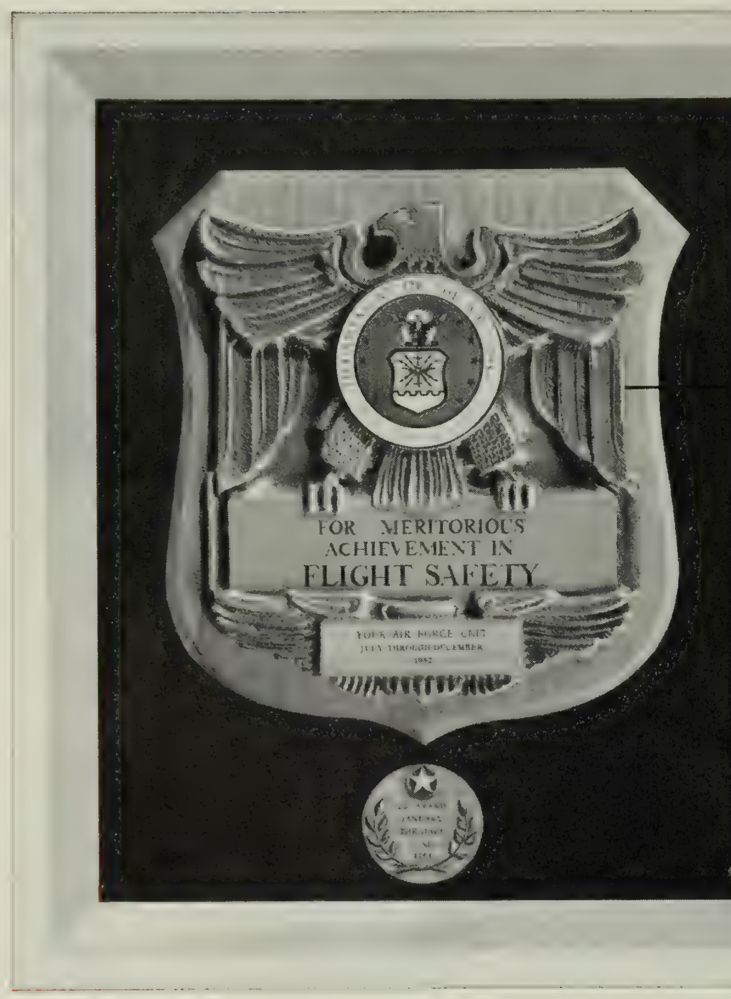


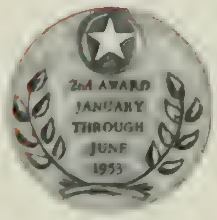
*Flying a Flameout*
page 2

*Lightning Strikes*
page 8



## the
## NEW

## the
## OLD



**Pictured above is the new Flying Safety Award Plaque, soon to be presented to those Air Force bases exhibiting outstanding flight safety records.**

**A departure from tradition will be the medallion, shown at the left. This will be awarded in lieu of a second plaque, when the same base comes up again for an award . . . sort of a cluster to the original "medal."**

VOL. 9 No. 5 MAY 1953

# FLYING SAFETY

Department of the Air Force The Inspector General USAF
Major General Victor E. Bertrandias,
Deputy Inspector General
☆
Brigadier General Richard J. O'Keefe, Director
Directorate of Flight Safety Research
Norton Air Force Base, California
☆
Lt. Col. John R. Dahlstrom
Supervisor of Flight Safety Publications

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***First FSO Class***—Here is the first class of flying safety officers to attend the USAF School for FSO's at the University of Southern California:

Back Row: Maj. J. M. Hall, Jr., Kirtland AFB, ARDC; Capt. W. B. Forbes, Kelly AFB, MATS; Capt. C. N. Wahl, Foster AFB, ATRC; Capt. J. H. Walther, Elmendorf AFB, AAC; Capt. D. E. Carter, Donaldson AFB, TAC; Capt. L. F. Droll, Baltimore, Md., ARDC; Capt. W. H. Maxwell, Langley AFB, TAC; Maj. E. H. Bentzer, Luke AFB, ATRC; Capt. R. R. Thomas, Bolling AFB, CAP; Maj. D. E. Fittor, Stewart AFB, ADC; Capt. D. J. Perry, Hunter AFB, SAC.

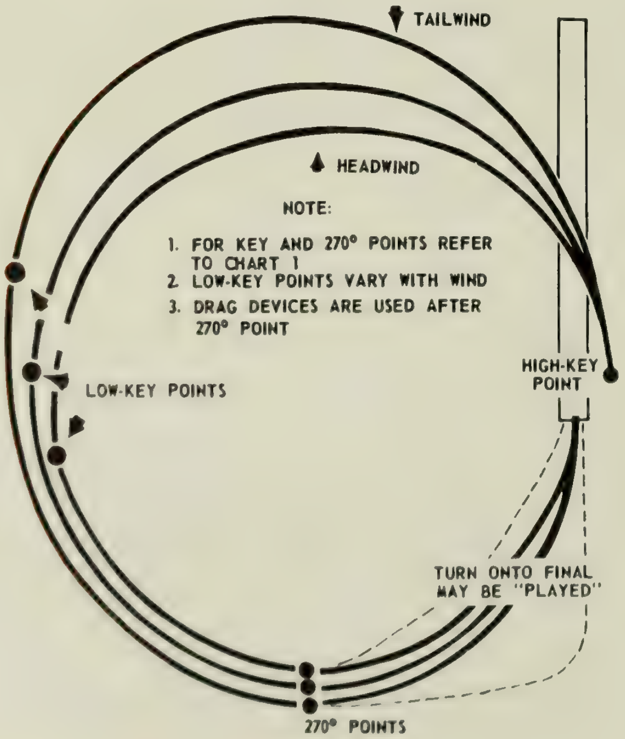
Second Row: Capt. J. W. Gunvordahl, Scott AFB, ATRC; Capt. T. E. Anderson, Yuma County Airport, ADC; Capt. C. N. Casteel, Maxwell AFB, AU; Capt. F. G. Nixon, Wright-Patterson AFB, AMC; Capt. P. Van Schuyler, Travis AFB, SAC.

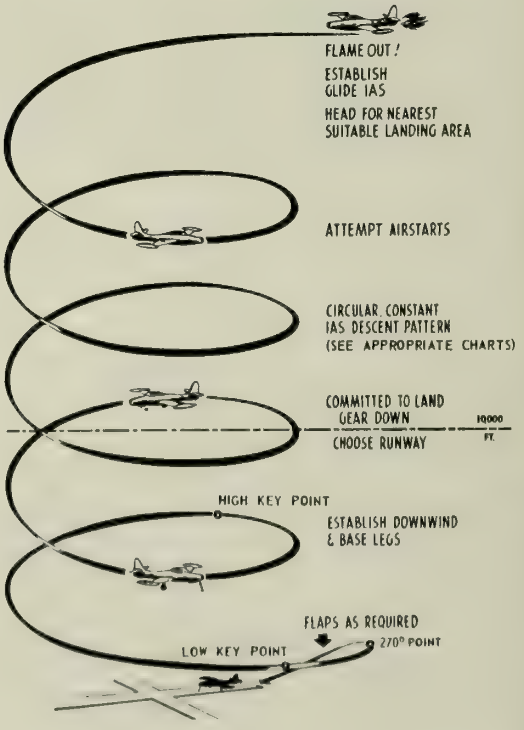
Front Row: Capt. H. B. Kinison, Washington, D. C. Hq. Command; Capt. J. J. Reichenbach, Donaldson AFB, TAC; Capt. J. S. Keel, Palm Beach Int'l Arpt., MATS; Capt. B. L. Davidson, Ladd AFB, AAC.

***This Month***—The flame-out landing yarn on page 2 is the result of many months of research by ARDC and "Steve" Stevens of the D/FSR Fighter Branch. Check this one for size, you jet jockeys. The full length feature on lightning strikes by Mr. Joseph C. Lingle, Wright Air Development Center, page 8, is authoritative handling of a technical and extremely important subject. Capt. Jack Moore deftly covers the problem of T-33 spins on page 14, and Lieut. Bill Johnston's tale of the "hard hat" on page 18 should be read by one and all. You should read and remember the Form 1-A story on page 25, because operations officers are screaming about countless errors and careless entries by pilots who should know better.

# FLYING A FLAMEOUT

**Scientific research and experiments with simulated flameout landings have resulted in revised techniques for deadstick landings in jet aircraft.**


TAILWIND
HEADWIND
NOTE:
1. FOR KEY AND 270° POINTS REFER TO CHART 1
2. LOW-KEY POINTS VARY WITH WIND
3. DRAG DEVICES ARE USED AFTER 270° POINT
HIGH-KEY POINT
LOW-KEY POINTS
TURN ONTO FINAL MAY BE "PLAYED"
270° POINTS



**By Major Robert M. Stevens. Fighter Branch, D/FSR**

EVER since the first pilot took off in his spit-and-paper kite, the problem of deadstick landings has been throbbing in the recesses of his mind. In the old days of the Spad, every landing was, for all general purposes, a deadstick . . . it had to be . . . that 90-horse Gnome Rotary had no throttle, and to make a landing you just cut the mag switch and blipped her on in to a walk-away landing.

Came the era of the carburetor, and the intrepid aeronaut still kept glancing around for a landing area, just in case his mill quit. And now, with jet propelled airplanes he still keeps his neck on a swivel and plans what he will do if he loses his fire. About the only *genus aviator* who doesn't worry about deadstick landings is the glider pilot, and he wouldn't know what to do with a throttle if he had one.

In order to further the science of putting down a jet job stone cold dead in de market, the Directorate of Flight Safety Research requested Air Research and Development Command to run a series of simulated flame-out landings in various types of jet aircraft. The results of these tests were described in the August, 1951, issue of FLYING SAFETY, and a detailed report was made on the findings, conclusions and recommendations in connection with the tests, These tests were based on research accomplished by the Directorate of Flight Safety Research in 1951 and were published together in a booklet titled "Jet Fighter Forced Landings." The Chief of Staff, USAF, recognized the importance of this training requirement and in October directed all major commands to initiate a simulated forced landing program.

A basis for the claim that this research has paid off in terms of aircraft dollars saved, is the letters received from all major USAF commands, outlining the number of successful (minor or no damage) forced landings accomplished in each command during the calendar year 1951.

These figures, coupled with data research by the Directorate's Records and Statistics Division, indicate that the U. S. Air Force-wide "practice" or simulated flame-out landing program has been extremely successful.

### Rate Decreases

Comparing two periods, the first from 1 November 1950 to 31 October 1951, and the second from 1 November 1951 to 31 October 1952, it was proven that the accident rate in this category decreased 29 per cent in the second period, as compared with the first period. This point is further emphasized by the fact that although total jet flying hours increased 48 per cent in the second period, the dollar loss increased only 11 per cent, for an estimated saving of several million dollars.

Because of the 175 successful forced landings, during both periods, as reported by the major commands and the Directorate's records, the savings in airframe costs alone is estimated at nearly 20 million dollars.

In order to bring all USAF major commands up to date on Project Flameout, a pamphlet is being prepared for early distribution, detailing the various changes and improvements in Section Three of the original study on Jet Flame-out Landings.

The addition will bring up to date all of the statistics and flight test data involving jet fighter forced landings in the latest models and will present the proper techniques to be employed in making actual flame-out landings, as well as serving for a basis of study and training for jet pilots. It is imperative that training officers in all major commands be familiar with the improvements in the original study, and that they incorporate these changes in all training programs under their jurisdiction.

This study of jet flame-outs is not static. It is set up on a continuing basis by Air Research and Development Command, in order to obtain ultimate information on jet flame-out landings under all conditions in present and future jet fighter types. In addition, the Directorate of Flight Safety Research continues to study and recommend new techniques, based on thorough analysis of jet fighter accidents, and this information will be disseminated to pilots through Pilots' Handbooks and other printed media.

Additional flight tests were conducted at Edwards Air Force Base in

### Pattern Altitude Variations

| *A/C Type* | *High Key Alt.—Ft.* | *Low Key Alt.—Ft.* | *270 Deg. Point Alt.—Ft.* | *Corresponding Rates of Turn Deg./Sec.* |
|---|---|---|---|---|
| **F-84G** | **3500- 7500** | **1700-3700** | **900-1700** | **4 - 2** |
| **F-86E** | **4000- 8000** | **2000-4000** | **1000-2000** | **4.5-2** |
| **F-86D** | **4500- 8500** | **2200-4200** | **1000-2000** | **4.0-2** |
| ***F-94C** | **8500-11500** | **4200-5800** | **2000-3000** | **2 - 1.5** |

---

**The F-94C pattern is designed around the handling qualities of the airplane without boost to be entirely safe in the event of boost failure in the pattern.*

### Flameout Simulation Data
### (Boost Off, Except for the F-94C, Speed Brakes Out)

| *Aircraft Type* | *F-84G* | *F-86E* | *F-86D* | *F-94C* |
|---|---|---|---|---|
| **Best Glide IAS—Knots (Gr. Up)** | **190** | **185** | **185** | **185** |
| **Avg. Rate of Desc. 25-12,000 ft. (Gr. Up)** | **1,650** | **1,850** | **2,200** | **1,900** |
| **Avg. Power—RPM-%, 25-12,000 ft.** | **65** | **72** | **79** | **79** |
| **Best Glide IAS—Knots (Gr. Dn.)** | **180** | **185** | **185** | **180** |
| **Avg. Power — RPM-%, 15,000′-SL (Gr. Dn.)** | **58** | **69** | **74** | **69** |
| **Rec. Alt. for Lowering Gr. (Ft. Abv. Grnd.)** | **12,000** | **12,000** | **12,000** | **15,000** |
| **Rec. Rate of Turn—deg./sec.** | **3** | **3** | **3** | **1.5** |
| ***Best Final IAS—Knots** | **150** | **150** | **150** | **160** |
| ***Rec. Touchdown IAS—Knots** | **120** | **130** | **135** | **120** |
| **Fuel Consumed, 25,000 ft.-SL. lbs.** | **100** | **235** | **165** | **205** |

---

**Assuming no wind and approximately 600 lbs. of fuel remaining.*

1952 to determine the best possible procedures in flame-out landings for F-84G, F-86E, F-86D, and F-94C aircraft.

In the analysis of this information it was discovered that certain basic changes would improve the previously recommended landing patterns. The major change in the original study is the modernization of the circular (360-over-head) landing pattern and the readjustment of key point altitudes as shown on the accompanying charts.

### New F-86 Proven

In addition, the revised Edwards AFB test report states that it has now been proven that the hydraulic irreversible "normal" flight control system on F-86E and F-86D airplanes is fully operable with the power provided by a windmilling engine. Another significant finding of the later tests is that landing flaps on F-86E and F-86D airplanes can be used on final approach as a result of the new inter-connected flap design.

Improvement of the pattern used in the early flame-out landing study was recommended by test pilots at Edwards AFB. This revision calls for three pattern points, with corresponding altitudes, rather than the two key points used in the original tests.

The first or "High-Key" point remains in the same geographical pattern location and is established on the initial approach at a specified airspeed and altitude with gear down and locked. At this "High-Key" point a specific and constant rate-of-turn should be started, and maintained until the 180-degree, or downwind point is achieved. Here is the point where decision must be made by the pilot, and depending on the prevailing wind, the pattern must be "played" from this point. Because this point (the 180-degree point) is a point of decision and is the spot where the pilot must make his first evaluation of his ability to hit properly the runway, it is now known as the "Low-Key" point.

The last significant altitude is at the 270-degree (base leg) point. From this point to touchdown, a successful landing is effected through the proper use of flaps, speed brakes, and if necessary, controlled side-slips and fishtails. (Consult the Dash One Handbook for flight restrictions on your aircraft.)

The aiming points on the runway remain unchanged. For a headwind condition, shoot for the midpoint of the runway; if a tailwind prevails, shoot for the first third of the runway.

### *Actual Flameout Data*

| *Aircraft Type* | *F-84G* | *F-86E* | *F-86D* | *F-94C* |
|---|---|---|---|---|
| **High-Key Altitude—Ft.** | **5,500** | **6,000** | **6,500** | **10,000** |
| **Low-Key Altitude—Ft.** | **2,500** | **3,000** | **3,500** | **5,000** |
| **Base (270 deg. pt.) Leg. Alt.—Ft.** | **1,300** | **1,500** | **1,500** | **2,500** |
| **Best Glide IAS—K. (Gr. Dn.)** | **180** | **185** | **185** | **175** |
| **Rate of Desc.—Ft./Min. (Gr. Dn.)** | **2,150** | **2,800** | **3,050** | **2,600** |
| **Rec. Rate of Turn (Gr. Dn.) deg./sec.** | **3** | **3** | **3** | **1.5** |
| ***Rec. Final IAS—Knots** | **150** | **150** | **150** | **160** |
| ***Rec. IAS at Touchdown—K.** | **120** | **130** | **135** | **120** |
| **Best Glide IAS—K. (Gr. Up)** | **190** | **185** | **185** | **185** |
| **Rate of Desc.—Ft./Min. (Gr. Up)** | **1,600** | **1,850** | **2,100** | **1,900** |
| ****Rec. Rate of Turn deg./sec. (Gr. Up)** | **3** | **3** | **3** | **1.5** |
| *****Rec. Alt. for Lowering Gr. Nor. Sys.—Ft.** | **12,000** | **12,000** | **12,000** | **15,000** |
| **Approx. Pattern Radius—N.Mi.** | **1** | **1** | **1** | **2** |
| **Avg. Windmill RPM Below Hi-Key-%** | **12.5** | **13** | **13.5** | **7** |
| **Avg. Test Time fr. Hi-Key to T.O.** | **2.2** | **1.7** | **1.8** | **3.3** |
| **Avg. Time for Gr. to Lock Dn.—secs.** | **25** | **15** | **27** | **19** |

**Assuming no wind and approximately 600 lbs. of fuel remaining.*

***Completely elastic depending on position and altitude.*

****Only if the field is definitely within gliding distance.*

*Rates of descent were taken at 15,000 ft. with gear up and 5,000 ft. with the gear down.*

### Landing Differences

At this point, the difference between emergency and forced landings should be emphasized. It has been decided that the following descriptions of a "forced" and an "emergency" landing will hold good.

An emergency landing is a precautionary landing made at the pilot's desire, and under conditions where he has control of power and flight controls.

A forced landing is a landing under conditions where loss of power control and/or partial loss of flight controls precludes further flight.

A word about canopies. It is important that all canopies be jettisoned in setting up the airplane for a forced landing. In emergency landings, sliding canopies should be opened and the jettisoning of clamshell canopies be left to the pilot's discretion.

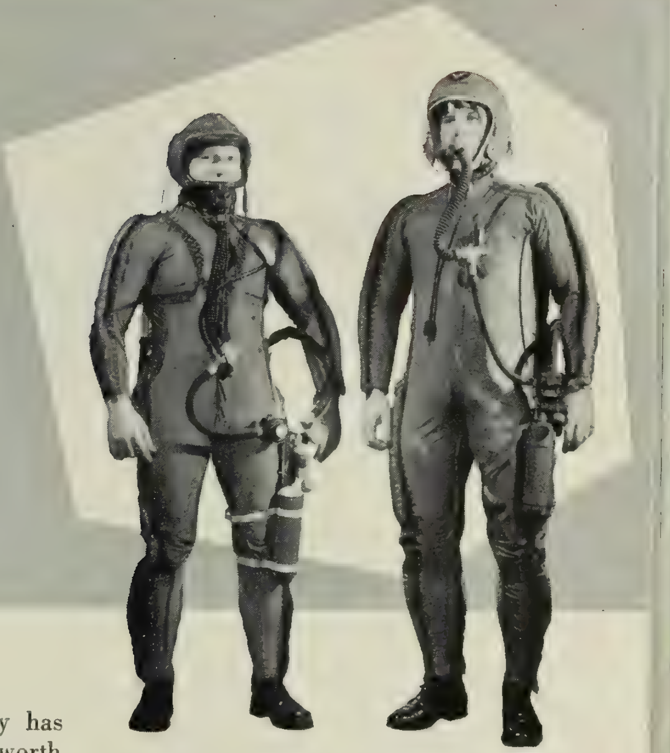
A recent accident involving the forced landing of an F-94 makes the point. Here the pilot made a forced landing at a base where fire and crash equipment were available. He missed his approach and crash landed off the runway. Fire was present in the aircraft. Both occupants were alive, but the canopy jammed shut. Fatal injuries resulted, not from the landing, but from the resultant fumes and smoke, which caused suffocation. Had the pilot jettisoned his canopy, a quick evacuation of the crew would have been assured.

Here is another moot point which you F-86E, D, and F jockeys had better paste in your P-1 helmet. Comes a turbine seizure (and you will know it when you get complete *but complete* loss of RPM), get ready to go over the side, buddy, unless you are over an established airfield at a fairly low altitude, and you are sure that you can make the field. Why? Because in the F-86E, F, and D models, without engine windmilling, your alternate flight control is dependent on the battery, and this battery may last only a few minutes.

Another point along this line: With a seized turbine, your rate of sink increases about 35 per cent. To illustrate, the rate of sink for an F-86A, clean, R/D, above 12,000 feet is 1600 feet per minute. This same airplane, with a seized turbine, under the same conditions, increases its rate of sink from 1600 feet per minute to 2150 feet per minute.

# Suited FOR SAFETY

### *THE AIR FORCE'S T-1 ALTITUDE SUIT HAS BEEN TESTED MORE THAN 700 TIMES ABOVE 63,000 FEET*



**Suit on left was worn by Maj. Chuck Yeager when he cracked the sonic barrier. Other suit is present model.**

THE U. S. AIR FORCE'S T-1 altitude suit assembly was developed to meet requirements for practical, lifesaving, emergency equipment for airmen who fly today's high performance aircraft at extremely high altitudes.

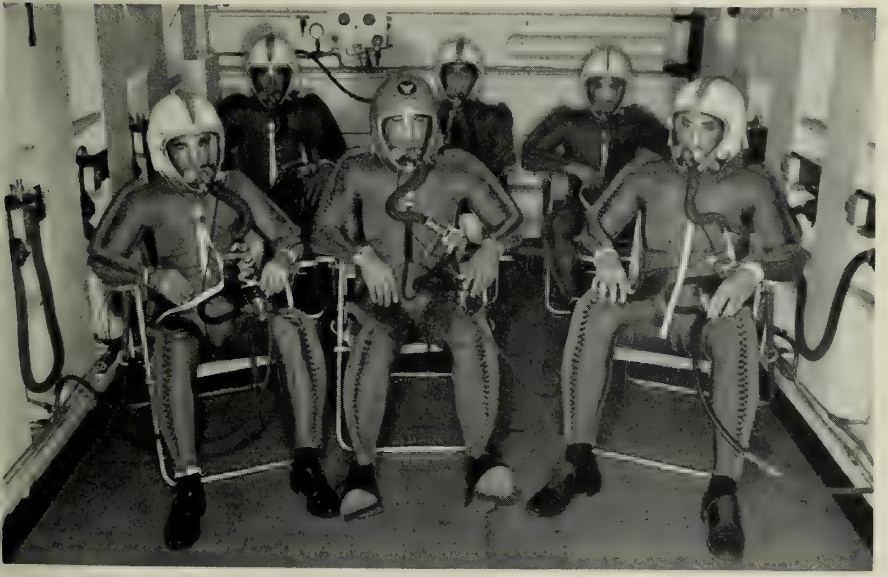
### Intensive Work

More than seven years of intensive team research were spent on the project by the Aero Medical Laboratory of the Air Research and Development Command's Wright Air Development Center.

Successfully tested to 106,000 feet in altitude chambers, the T-1 has been worn in high altitude test flights for the past five years. It already has saved several lives and aircraft worth approximately 18 million dollars.

In 1947, Major Charles Yeager, wearing the early model of the T-1, flew the Bell X-1 research plane faster than sound for the first time. Then, in 1950, Lt. Col. Frank K. Everest, wearing the T-1, and flying the X-1 to extreme altitude, lost cabin pressure accidentally. His suit operated automatically, giving him protection until he could reach a safe altitude. In 1951, Mr. William Bridgeman, flying the Navy's Douglas D-588-11, wore the T-1 while establishing the record human flight altitude of 79,000 feet.

**The T-1 High Altitude suit has been tested more than 700 times.**



### 700 Tests

Military and civilian scientists back at the Aero Med Lab have conducted more than 700 tests on the suit at simulated altitudes above 63,000 feet. On three occasions, tests have been conducted with the suit at a simulated altitude of 106,000 feet, which represents a 99 per cent vacuum.

In addition to fulfilling initial protective requirements, the suit also combines in one "package": anti "G" or blackout protection, communication equipment, oxygen valves and regulators, protective helmet, protective visor (with defrosters) and oxygen bailout cylinder.

### Helmet Tested

It is interesting to note that the helmet part of the assembly has successfully undergone windblast tests conducted at mach 0.998 (s.l.), or approximately 725 MPH.

The men who worked on the development of the T-1 suit are rightfully proud of their handiwork, but there's one thing they don't like to hear. When you're in the Aero Med Lab, it's not safe to refer to the suit as a "Buck Rogers Space Suit." Just call it the T-1, and let it go at that. ●

# THAT PERILOUS PROPWASH

***Smaller aircraft which elect to follow their larger brethren too closely on takeoff and landing often find that they are borrowing more trouble than they can safely handle.***

THIS story is directed to you people who have a tendency to lock on to a landing transport airplane and follow it too closely around the landing pattern; to those of you who tail in too close to a landing airplane on final, and to you who take off too closely behind four-engine aircraft.

Propwash, called "big plane turbulence" by researchers, can, and does play hob with smaller aircraft landing and taking off too closely behind multi-engine airplanes.

Figures show that four-engine transports set up the highest propellor turbulence. This turbulence has been severe enough to cause major accidents not only to light planes, but to following aircraft as heavy as C-60, B-26, C-45, and C-47's.

With the increase in jet fighter traffic, it is increasingly important that both follower and followee be cognizant of propwash hazards, because jet fighters can be placed in the "light airplane" class.

Laboratory and field tests show that an airplane landing, taxiing or taking off creates what are known as "wing tip vortices," or swirls of moving air rolling back off the wingtips at varying velocities, depending on the speed of the aircraft. These vortices are funnel-shaped, of comparatively small diameter at the trailing edge of the wing itself, and spreading into a wide cone, that gradually dissipates several hundred feet behind the aircraft. Naturally, the force of the turbulence caused by the air flow over the wing tips dissipates as the vortex grows wider. Propeller wash is found in varying intensities below the belly of the airplane, usually a little to the right of center.

In flying cargo glider tows, it has been found that in flying down through the propwash of a C-47, turbulence in level flight was encountered from about ten feet below the horizontal stabilizer of the towing aircraft to about thirty feet below the towing aircraft; and was of highest intensity at about twenty feet to the right, and below, the C-47 rudder plane. Propwash was encountered from 150 to 350 feet behind the towing airplane, often of such intensity, that full opposite aileron and rudder were necessary to preclude the glider from completely rolling on the axis of the towline.

Here are some actual examples of accidents and near accidents caused by propeller turbulence, in the words of the pilots themselves.

### No Warning

Says a pilot, "I took off from Zurich Airport. It was a beautiful calm evening, no wind stirring. About a minute ahead of me, a four-engine transport had also taken off, but when the tower cleared me, the transport was out of my field of vision. My takeoff was smooth, and I had flaps and gear up, when *without the slightest warning*, my airplane went into a vertical bank. Applying full aileron, I brought the ship level, but at once the same thing happened again. I applied full aileron again, but a third time the airplane went into a vertical bank. By this time my altitude was 90 feet, and I was approaching the end of the runway, and an obstruction loomed ahead. I thought there was some mechanical defect on the controls, so I cut the gas and made a belly landing at the edge of the airport." This pilot had about 2000 hours, much of it in Alpine turbulence, but he had never encountered this type of roughness, where there was no warning whatsoever. There was no noticeable gust or turbulence. At a 90-knot climb-out the airplane suddenly went out of control for no apparent reason.

Says a B-17 pilot, "I was making a routine night landing, spaced approximately one mile behind another landing B-17, when I encountered propwash at about 100 feet altitude, about 100 yards short of the landing runway. The turbulence was so severe that I had to abort the landing, and make a go-around. My airplane was thrown into a nearly vertical bank. and I had to give it full opposite rudder and aileron for what seemed several seconds, before positive control was obtained. I feel that the aircraft surely would have been damaged if I had attempted to make a landing in this low altitude turbulence."

Here is what happened to the pilot of a Lockheed Lodestar (C-60), which is hardly in the lightplane category. Says the pilot, "In one particular instance, during a landing at Washington National Airport, I was coming in at approximately 1000 feet behind a C-47, at an altitude of about 200 feet. During this approach, I got into the propwash of the C-47, and my airplane was thrown into a 60-70 degree bank. I managed to straighten out the airplane, but this propwash came very close to upsetting me completely, and causing a major accident.

The pilot of a C-47 reported, "We were about to leave Chicago Municipal. After we completed our check, the tower granted permission to take off. We did so just as a "Connie" ahead of us became airborne. It took both the copilot and myself with every thing we had, to keep the C-47 from doing a complete roll. We had to use full travel from right to left aileron."

Cited above are only a few of the many actual instances where propwash has become a definite flight hazard in the takeoff and landing phases of flight. This hazard is caused basically by the wing tip vortices and the swirl of the propeller wash.

An invitation to a major accident—failing to get proper spacing in the pattern when following another aircraft.

### Emphasis on Spacing

With airport traffic, both military and civilian, on the increase; with transport and cargo aircraft growing larger and larger, and with jet fighter activity in the vicinity of busy airports a factor which must be recognized, the importance of aircraft spacing cannot be too strongly emphasized.

Here are some recommendations which should be followed by pilots landing behind large airplanes:

- Don't tail in too closely behind the airplane in front of you. Be conservative, and allow plenty of space between aircraft.
- If possible, make your approach and landing on the upwind side of the runway, to allow turbulence to drift away from the actual runway landing path.
- When you enter an area just vacated by another airplane, maintain adequate flying speed, well above the stalling speed for your airplane.
- Above all . . . be alert and be prepared for turbulence when you are in a congested traffic pattern.

# Lightning strikes . . . .

**By Joseph C. Lingle, Wright Air Development Center**

ANY aircraft flying at any altitude at any speed in any locality, under certain atmospheric conditions, can be struck by lightning. Such strikes can cause extensive damage to the aircraft and possible injury to flying personnel.

Many of the mysteries of atmospheric electricity have been solved, but in designing and building today's aircraft with ever-increasing emphasis on greater speeds and higher altitudes, a solution of any unsolved mysteries is essential if protective measures are to be effective.

Even to define or explain lightning is difficult. Webster defines it as "The flashing of light produced by a discharge of atmospheric electricity from one cloud to another or from a cloud to the earth."

In thunder clouds the vertical air movements may result in a positive or negative electric charge accumulations or areas. These particles accumulate or build up to a point beyond which the air can no longer act as an insulator. It is at this point that the accumulated charges tend to move in the direction of greatest electric stress resulting in a violent electric discharge accompanied by a blinding flash with a loud noise which we commonly recognize as lightning.

Few of us realize that there is an average of 44,000 thunderstorms in the world every day or 1,000 thunderstorms over the earth at any given instant and that from these, 100 lightning discharges will be released each second. Also, lightning discharges which follow the path of least resistance may pass from one cloud to another cloud, from one cloud to the ground, from one portion of a cloud to another portion of the same cloud or from a cloud to clear sky.

### Discharges Are Erratic

The discharges themselves often progress in very random or zig-zag fashion as their probing tips produce high electrical stress in directions that had not been stressed before. These discharges may wander for miles without necessarily going either to the ground or to another cloud, therefore a strike may occur to aircraft even outside a thundercloud and the discharges that an airplane may intercept can vary widely from heavy strikes down to very small streamers sometimes referred to as static-discharges.

A review of some 200 reports filed by pilots of the USAF, Navy, Army and commercial airlines who have experienced lightning strikes discloses the effects of discharges to the aircraft. It is quite clear, as you will see from several excerpts of these reports, that lightning is certainly a major factor that requires adequate protective measures.

On May 5, 1952, a C-45, flying over

This damage was incurred during a violent thunderstorm.

VHF antenna on an airplane can act as a lightning rod.

western Montana at 11,000 feet at an airspeed of 140 and an air temperature of 10°C., suffered a strike. The following is a report of the damage done to the electronic equipment:

- Antenna mast burned and splintered.
- VHF transmitter and receiver damaged.
- Low frequency antenna relay and antenna burned off.
- Sense antenna destroyed.
- Compass receiver inoperative.
- Voltage regulator burned out.
- Both batteries dead.
- Right magneto in right engine faulty.
- Air frame damaged.

On July 28, 1952, a pilot of a BT-13A flying over Poston, Arizona, was struck by lightning. This is the pilot's report: "While flying along about 600 feet over the desert looking for a lost plane, there was a little rain shower to my right wing and some flash lightning. Then, all of a sudden a flash burst in on my right wing—that was all I remember till I came to. The plane hit the ground and knocked the engine out. Some people don't believe that lightning will hit you in a plane, but I have proof of it on my back—three big burns about 12 inches long. The plane was a total loss."

On a routine flight from Quonset Point to Argentia, Newfoundland, a P2V-4 encountered some rough weather. Stormy flying in this area is nothing new, but when a jolting flash shook the airplane and sent sparks flying all over the sky, the crew knew they had been hit by lightning. The aircraft completed its flight but when it reached its base, it was found that all steel parts, such as propellers, engines, oleos, retract pistons, control cables, nose guns and even armor plate were highly magnetized. The charge was so great that when checking the airplane it was found that washers, screw drivers and other parts would hang unassisted from affected parts.

A C-47 at Lancaster Airways Intersection on May 18, 1950, was flying at 9,000 feet when struck by lightning. The ADF belly antenna was melted, the de-icing motor was fused, two holes were burned in the alcohol supply line, permitting fluid to saturate spun glass insulation around the heater duct which was instantly ignited, and the right elevator was damaged.

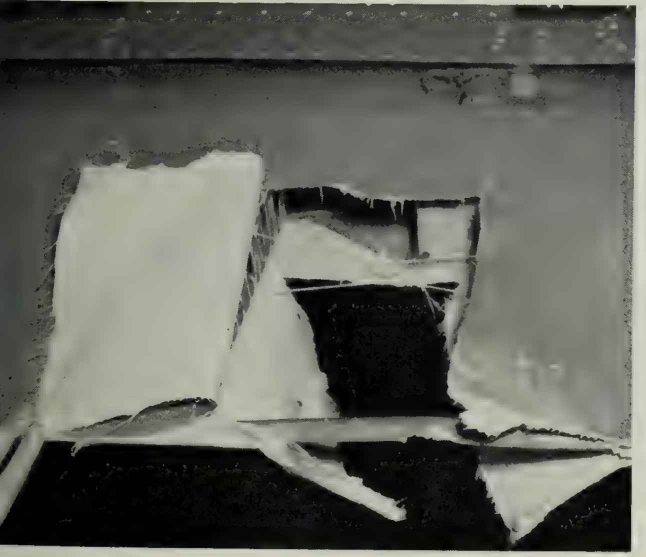
On February 4, 1952, an air carrier reported "Lightning strikes on nose of aircraft at 1503 EST—OAT −5°C. in precipitation, on instruments, altitude 10,000 feet. Noticeable static buildup prior to strike. Concussion of discharge and flash seen and felt in cockpit. Flash and report heard in cabin. Magnetic compass approximately 50° in error, apparently on account of lightning strike. Aircraft terminated Cleveland on account of lightning damage."

### Major Strike Damage

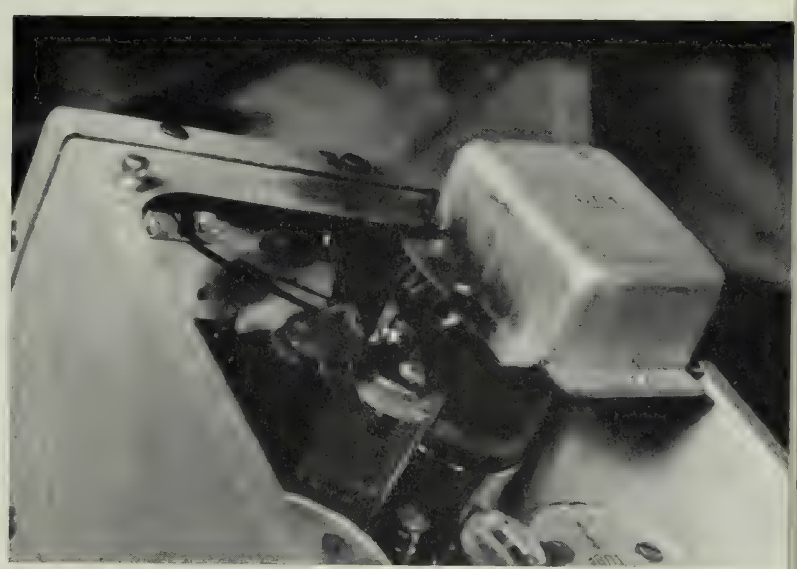
The following damage was recorded after inspection by maintenance personnel:

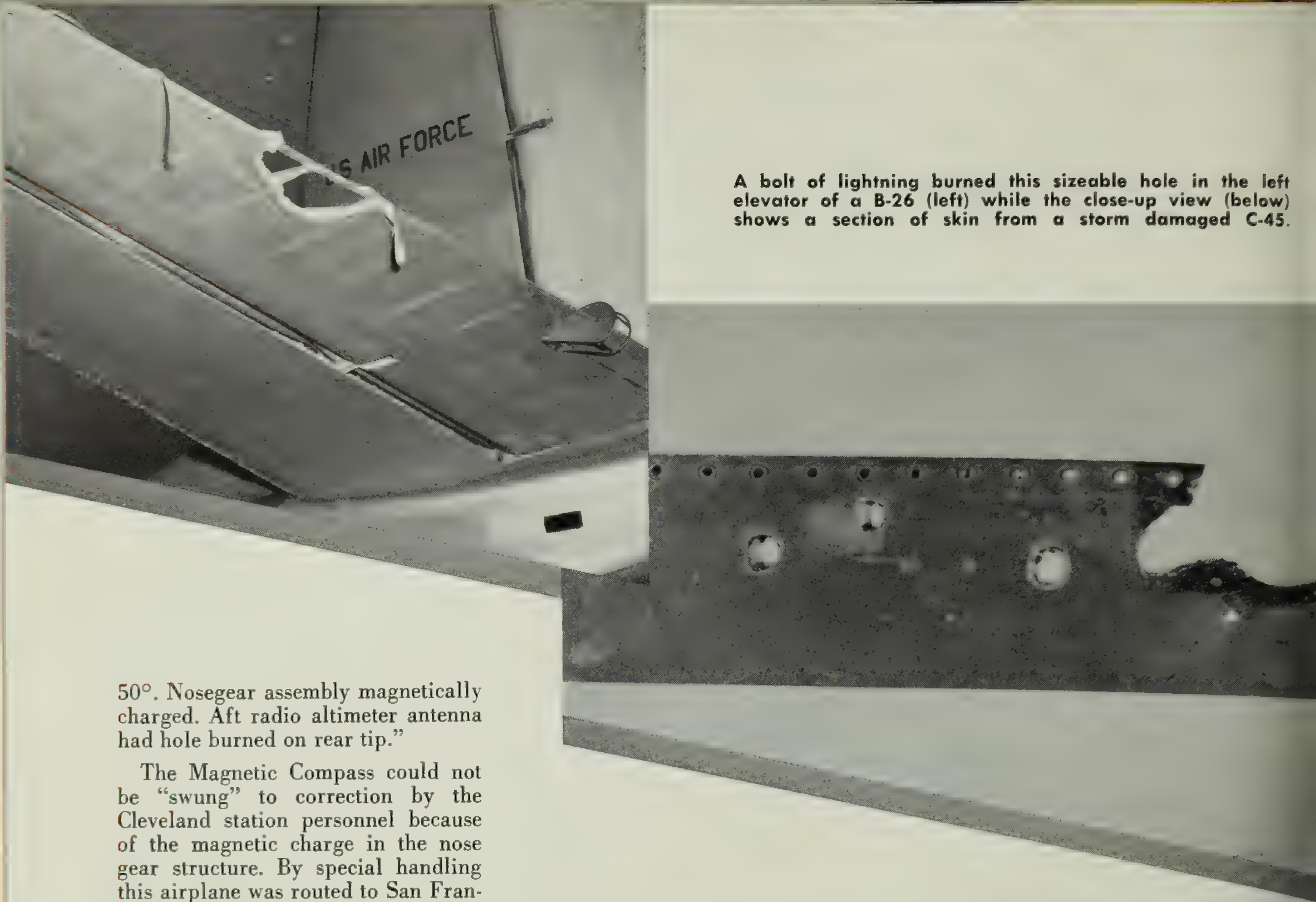
"Right nosegear door had $\frac{3}{8}$ inch hole and paint burn for an area, approximately three feet long and two feet wide. Door bent and buckled in several places. Pulled rivets on trailing edge. Left door had scorched area two and one-half feet long by one foot wide with no apparent physical damage. Right pitot mast had several pit marks at the lower base. Right side of fuselage at Station 14 at eight o'clock position (facing plane) had $\frac{1}{8}$ inch hole. Right side above nose door covered with raised pimples. Right elevator trailing edge, aft of top hinge, burned through and approximately twelve rivets were popped on both top and bottom. Hinge bracket and elevator (outer tip) were warped and burned. Magnetic Compass off

**A Georgia thunderstorm caused this aileron damage.**



**This VHF transmitter was damaged by lightning.**





**A bolt of lightning burned this sizeable hole in the left elevator of a B-26 (left) while the close-up view (below) shows a section of skin from a storm damaged C-45.**

50°. Nosegear assembly magnetically charged. Aft radio altimeter antenna had hole burned on rear tip."

The Magnetic Compass could not be "swung" to correction by the Cleveland station personnel because of the magnetic charge in the nose gear structure. By special handling this airplane was routed to San Francisco for assistance by the Engineering Department in making the correction to the Magnetic Compass System.

A DC-6 flying over Matawan, New Jersey, on March 13, 1952, at 6500 feet, airspeed of 180, air temperature −13°, suffered a strike. Upon inspection, numerous holes from a quarter size to a pin head size were found on the left nose of the aircraft. Also, plastic cone cover, bulbcover and wire clip retainers on the extreme end of tail cone were blown off. Holes also were noted in aft end of tail cone. The pilot reported a loud concussion accompanied by a ball of fire on the left side of the nose of the aircraft. A loud noise was heard in the cabin and fire was noted over the left wing of the aircraft in the vicinity of No. 1 engine. The odor of ozone was noted immediately after the discharge.

Another DC-6 flying between Tyler, Texas, and Shreveport, Louisiana, at 15,000 feet was struck on the nose and right wing, filling the cockpit with smoke.

Lightning passed over the pilot's lap and struck the flight engineer on the left hand, causing shock and small burn on his wrist.

Wires leading in from top of antenna, burned to powder. Both transmitter and receiver on high frequency burned out. Flight engineer's hat in radio rack was full of small holes.

### Confusion Factor

In the opinion of leading authorities, fatal accidents could occur as a result of a severe lightning strike which might not damage the aircraft nor injure personnel but which might confuse the crew, causing them to lose control.

Confusion is one of the greatest causes of pilot error and unquestionably, lightning could have a confusing effect on a pilot.

Mr. L. P. Harrison of the U. S. Weather Bureau, in his Technical Note, "Lightning Discharges on Aircraft and Associated Meteorological Conditions," for the National Advisory Committee for Aeronautics, states that the effects on pilots of atmospheric electrical discharges to aircraft may be divided as follows: Visual, Aural, Electrical, and Psychological.

Visually, the discharge generally takes the character of a blinding flash the effect of which is usually of rather brief duration. When the flash occurs, there is usually a blindness lasting from a few seconds to as long as three minutes. The more severe effects are during the hours of darkness. The most severe case reported involved a copilot who was unable to see for eight minutes after the discharge although the pilot of the same aircraft had normal vision 10 seconds after the discharge.

In the aural aspect, the lightning discharge usually is accompanied by a sound. Pilots have described this noise as follows: dull thump; snapping sound; sharp crack; like an explosion; violent noise; deafening crash of thunder.

The sound ordinarily does not seem to cause more than a momentary loss of hearing, some confusion by the bright flash and other psychologically disturbing factors attending the discharge.

Illustrative of the most extreme effect reported as due to the thunder, is the following excerpt taken from remarks made by a passenger on an airplane. "About 15 minutes out, the plane passed through a very violent weather front encountering severe rain and sleet. Immediately upon passing through the front area and after the rain and sleet had stopped, fire streaks approximately eight inches long were observed in the propellor disk areas at about the propellor tip radius. This condition was observed on the right propellor while another passenger who was sitting on the left side of the airplane, noted the same condition on the left propellor. About one minute after this discharge of St. Elmo's Fire, a violent electrical discharge took place from the airplane to the surrounding atmosphere. A large ball of white fire approximately six to eight feet in diameter appeared to envelop the right engine nacelle and engine propellor unit. At the instant this fire appeared, there was a resounding crash which deadened the hearing senses.

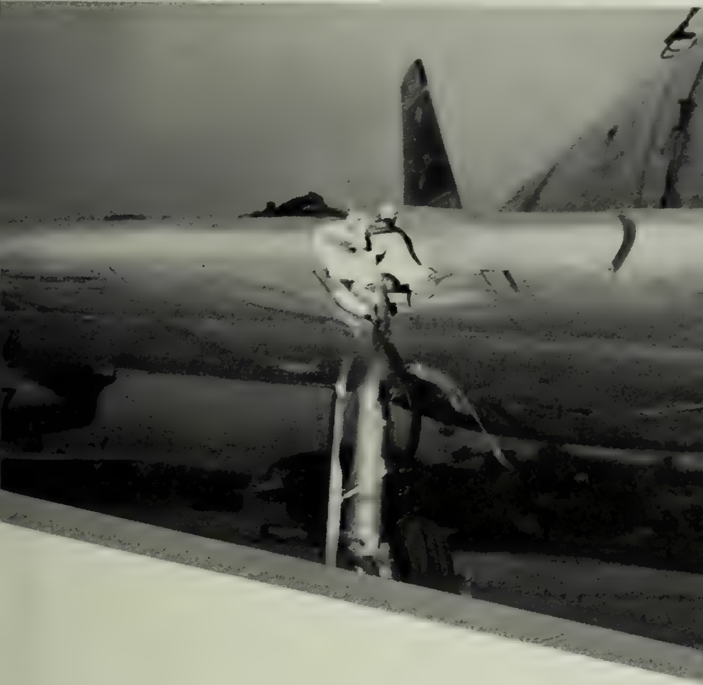
"Immediately after the discharge and noise, everything seemed to stand still, and there was a lull, uninterrupted by noise. This, I believe, was due to my sense of sight and sense of hearing being temporarily impaired, and not due to any actual stoppage of airplane engines. I believe that the engines continued to operate normally during this lull and immediately I regained my full equilibrium and noticed that the pilot had turned back. The passenger told me that he had noticed the same sort of discharge at the left wingtip of the airplane and that he experienced the same feeling as I had, with respect to senses."

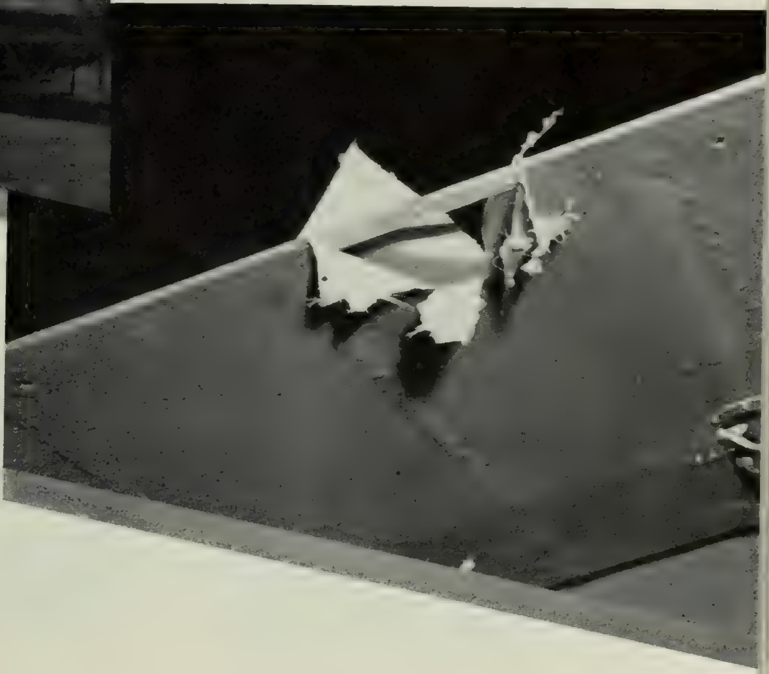
### Current Surge on Radio

Another effect on the hearing can result from a very sharp click in the earphones due to the surge of current in the radio circuit when the antenna or radio forms part of the discharge path. It is thus possible to receive acoustical shock if the earphones are closely fitted, the saturation characteristics of the vacuum tubes in the radio receiving set are not such as to limit greatly the intensity of acoustic disturbances produced electromagnetically in the head receivers, and the earphones do not have a suitable stop to prevent excess motion of the diaphragm caused by the discharge (current surge). Suddenly released pressure above a certain value produced in the ear canal by the abrupt metallic earphone click can be uncomfortably loud, accompanied by momentary dizziness and ringing in the ears. In extreme cases, unconsciousness may result. This seems to have happened in one or two cases.

In one other instance the pilot reported that his ears hurt for 15 or 20 minutes, probably because he had the earphones on at the time of the discharge. Wearing a headset close to the ears when circumstances indicate a discharge may be imminent is therefore considered inadvisable. Earphones with appropriate protective features are desirable.

Electrically, pilots have reported seeing sparks inside the cockpit on a few occasions, but in no case was any serious harmful effect indicated where an all metal aircraft with all metallic parts bonded was involved. One pilot reported he felt shock on hands and feet in a blinding flash on the aircraft's nose in front of the



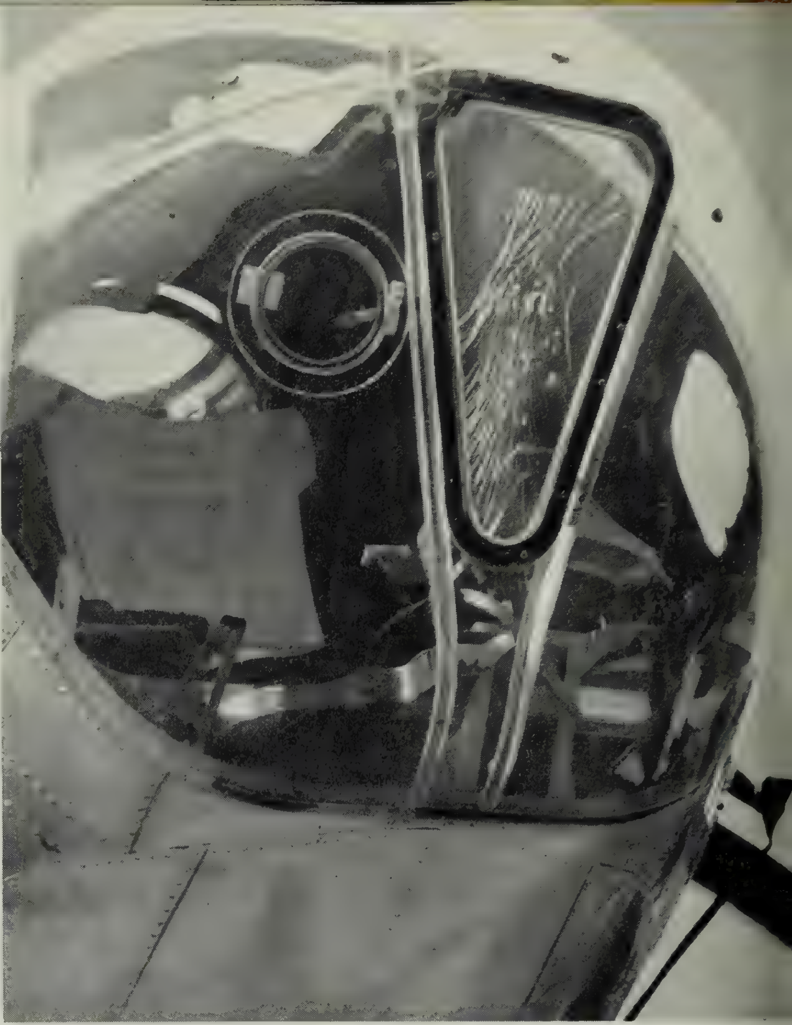


While most lightning strikes are made on slow-moving aircraft, fighters aren't immune as this picture of an F-86 will show (above). Lightning strikes a C-47, damaging the left aileron (right) and burning the static eliminator.

left cockpit window. One engine stopped for a few seconds. No apparent damage was noticed afterwards. Another report states that the flight engineer had his hand resting on the captain's seat, and after the incident discovered the hair had been singed from the back of his hands.

Psychological effects are not always caused by the lightning and thunder. Sometimes they result from the severe characteristics of thunderstorms in which the lightning may be encountered. Thus when an aircraft flying at considerable speed enters an extremely turbulent region within a strongly developed thunderstorm, momentary panic may seize the persons on board, in view of the conditions experienced.

For a very brief time the airplane then may undergo violent rolling, pitching, and yawing motions, accompanied by severe jarring and rocking of the craft and its controls, in addition to violent airspeed fluctuations and irregular accelerations, all of which are attended by noises of unfamiliar character and varying intensity. Usually, the space in which such severe turbulence occurs is narrow. The brilliant flash of the discharge, the usually accompanying loud noise, and the concussion, generally frighten the pilot for an instant and produce momentary confusion. He becomes startled and his reactions are slow and faulty for a short time interval. If the flash occurs at night and the temporary blinding effect is severe, the pilot is under the handicap of not being able to see his instruments or controls for a brief period.



**A terrific jolt of lightning damaged the nose of this B-17. The center section is bulletproof glass. All antennas were burned off.**

**In addition to structural damage, lightning can so magnetize an airplane that compasses will become inoperative.**

### Recommended Procedures

The following flight procedures are recommended to avoid lightning strikes and to alleviate harmful effects:

- Avoid flight through large or towering cumulus and cumulonimbus clouds, especially at levels where the temperature is from −7°C. to +5°C.
- Avoid flight within 2500 feet of cumulonimbus clouds, especially when they have given manifestations of thunderstorm activity.
- Avoid flight through moderate or heavy rain and/or snow, sleet, hail or ice crystals especially at levels where the temperature is from −7°C. to +5°C., particularly if the precipitation is from cumuliform clouds.
- If the precipitation static and/or corona discharge (St. Elmo's fire) is moderate to severe, and there is evidence from the temperature, cloud and precipitation conditions that the aircraft is in a zone of strong potential gradient, reduce speed somewhat and seek a lower level where temperatures above +5°C. prevail, or leave the given cloud and precipitation conditions.
- If existing conditions are favorable for a discharge, be sure the antenna is grounded. The trailing antenna, if used, should be reeled in.
- If the signs are sure that a discharge might be expected, have the cockpit lights turned up full bright and keep the eyes focused on the instrument panel. Wearing opaque glasses, sun glasses or a long visor which shields the eyes from any lightning flash that might be seen through the windows is also recommended.
- The auto-pilot should be set up with the servo controls turned down so that it can be immediately en-

gaged in the event the crew is temporarily blinded.

- If signs are such that a discharge might be imminent, do not hold headphones too close to the ears. This will tend to prevent acoustic shock.

The above rules are certainly logical when an aircraft is unprotected for lightning. Professor M. M. Newman, Director of the Lightning and Transients Research Institute, has commented that if airplanes are to fly in regular service, they cannot very well keep avoiding likely discharges or dispense with communication by grounding antenna, and therefore much of the measures for safety should be incorporated into the aircraft itself. Prof. Newman stressed that as far as lightning itself is concerned the all-metal aircraft inherently forms a safe discharge current diverting path around occupants and equipment in the interior.

By proper protection that can be provided by the plane manufacturer, hazards such as lightning entering inside along the antenna, illustrated in the earlier pilot's reports, can be eliminated. Actually, modern aircraft can be made completely safe from lightning and that lightning areas will then need be avoided only because of related turbulence.

In most instances the effects of lightning strikes on aircraft are not serious, in the true sense of the word, but they are always expensive. When an aircraft is struck by lightning it must be taken out of service. All communication and navigation equipment must be re-calibrated. Maintenance checks are necessary and any damage must be repaired or parts replaced. This all adds up to loss of valuable flying time and increased maintenance costs.

Accurate reports of instances of lightning strikes filed by pilots, is the main source of information on this subject. The importance of these reports cannot be overly emphasized.

**The Air Force is working with designers and manufacturers in a series of tests to determine a defense against lightning.**

For example, such reports have supplied in the past and will continue to supply in the future the information necessary to design and equip aircraft to defend it completely against lightning.

From pilot reports definite facts have been disclosed. They have shown that aircraft have been struck by lightning on the ground and at altitudes from 200 feet to 45,000 feet. The altitude range, wherein strikes have occurred most frequently, is from 6,000 feet to 11,000 feet above sea level, and 4,000 feet to 9,000 feet above ground. From these same reports there is strong evidence to support the theory that large aircraft encounter more strikes than do the smaller.

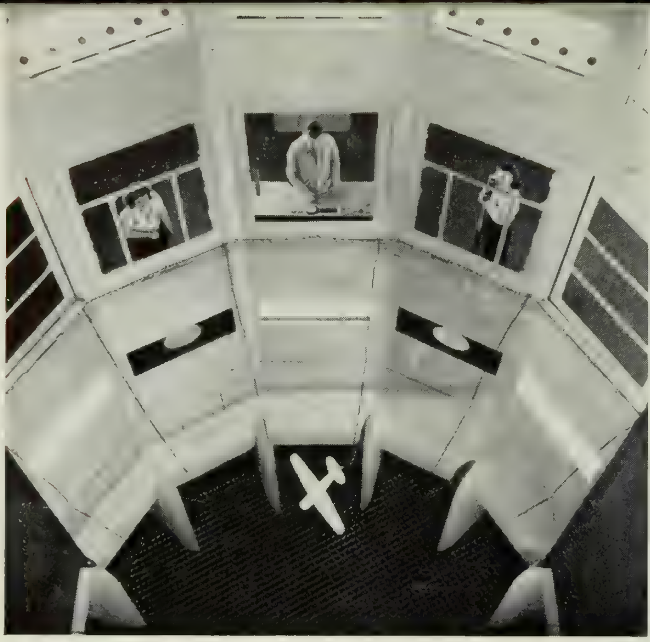
A majority of the strikes reported occurred when the temperature was near the freezing level or in the range of +2°C. to −3°C., air temperature.

Most strikes have been reported in the spring and autumn, between noon and 1800 hours. However, strikes have been reported during every month of the year. Strikes usually occur when the aircraft is flying through or in the vicinity of thunderclouds. Lightning has no favorites in types of aircraft it will strike.

### Impossible to Prevent

Although it is impossible to prevent lightning strikes the all-metal bonded aircraft is inherently protected from lightning damage by the conductivity of its aluminum skin. Thus the only points of entry to the aircraft by a lightning strike are through antennas and on plastic surfaces such as canopies and domes.

An associated problem in thunderstorm flying is the effect on radio communication. Each lightning strike within 100 miles or so of the aircraft produces a strong burst of "crash static." Corona, or "St. Elmo's fire," produces a continuous squealing, hissing sound in the headphones which marks desired signals. The ADF needle of the radio compass should never be relied upon in these circumstances, and range signals should be identified by the tone in the headphones, if identification is possible. As this problem of "static" is as complex as the problem of lightning hazards it can only be briefly mentioned here and given the more comprehensive treatment it deserves in a separate article.


**Before actual spin tests are made, experts run lab checks on various single-engine aircraft design configurations.**

# Spin-testin

## The experts say spin reco depend on two factors—co

IN recent months the T-33 has become the subject of discussion in many of the inevitable hangar flying sessions prevalent whenever two or more Air Force pilots congregate. Speculation has centered around the spin characteristics of the aircraft, particularly as to what constitutes the proper recovery technique.

The aircraft manufacturer, under Air Force contract, ran a series of spin tests and is in the process of rewriting the Dash One Handbook on certain phases of the T-33. So far, approximately 80 spins have been performed and test pilots state that, "Under favorable conditions, the T-33 spins consistently well and recovers easily if the proper techniques are used."

Favorable conditions boil down to just one thing: proper configuration. Intentional spins are and have been prohibited in the T-33; but if a pilot enters a spin inadvertently, he should attempt to get proper configuration at once. The most favorable configuration, as recommended by factory pilots is:

- Tip tanks installed but empty.
- Throttle in idle position.
- Guns and ammunition installed (or equivalent weight in ballast).
- Ailerons in neutral.
- Gear and flaps retracted.
- Elevator up travel limited at 20 degrees.

In discussing the configuration in detail, test pilots pointed out the importance of empty tip tanks. They recommended that manuevers which might cause the aircraft to approach the stalling point and induce an inadvertent spin be practiced after the tips were emptied. It was stressed that fuel in the tip tanks has an adverse effect on spins and spin recovery. In any spin that develops—either a normal, erect spin or an inverted spin—if there is no response toward recovery, the tanks should be jettisoned if they contain fuel. However, if the tanks are empty, it is desirable to retain them as they will be beneficial to the recovery rather than detrimental.

Retarding the throttle and keeping the ailerons neutral are SOP for most aircraft spin recoveries; use of either only aggravates the spin condition.

Gear and flaps in the extended position also aggravate a spin in the T-33. A pilot should retract both as soon as possible to aid his recovery.

The elevator up-travel limit of 20 degrees is required by tech order for the T-33. The 20-degree limit has been determined as the best setting for recovery by the spin tests.

### Ballast Needed

It was determined by the spin tests that either guns and ammunition should be installed or a ballast of from 300 to 330 pounds will be necessary for proper spin recovery. All aircraft which are picked up at the factory for delivery have 300 pounds of ballast added. Test pilots also recommend that no maneuver that could possibly cause an inadvertent spin be performed after ammunition has been fired.

In a normal spin, the nose of the aircraft will oscillate between a nose low position and one in which it rises to, or near the horizon. The recovery should be accomplished when the nose is low, below the horizon and not when it swings high in the oscillation.

With one extremely important exception, spin recovery is much the same as in most aircraft. The throttle should be in idle position with the ailerons held in neutral but with the stick held *aft.* A smooth pressure is applied to the rudder against the spin, to slightly less than full travel. Finally, back pressure on the stick is released, *after* spin rotation has stopped.

*The stick must be held aft till the rotation stops; popping it or an abrupt, full forward motion will probably throw the aircraft into an inverted spin.*

The importance of allowing the airspeed to build up after recovery was emphasized by test pilot Tony Le Vier. He commented, "Once rotation is stopped you have no sweat. Just ease off the back pressure and allow plenty of time for the airspeed to build up to a point of safety.

"Leveling out and bringing the stick back too soon, without giving

# the T-33

**haracteristics in the T-33**
**chnique, proper configuration.**

According to factory test pilots, proper spin recovery can only be effected when the tip tanks are empty.

the aircraft a chance to attain an airspeed well above stalling can easily result in a secondary spin."

Inadvertent spins result from aggravating a stall condition. Pilots are warned that when practicing stalls or gliding turns, recovery should be made upon receiving an initial stall indication rather than awaiting complete loss of control.

Inverted spins may occur if the aircraft is stalled in an inverted position while doing an acrobatic maneuver or by pushing the stick forward abruptly during recovery from a normal spin. In the latter case the inverted spin will start from an upright attitude.

Test pilots warn that "Inverted spins in this aircraft are fast, uncomfortable and confusing. *Don't invite this condition.*"

The only indication that the spin is inverted may be that the pilot is thrown against his safety belt. It is important that he recognizes this condition because the T-33 may be spinning inverted and still give the impression that it is in a normal, erect spin. Test pilots stated that several times during spin tests they became confused and had trouble getting orientated due to unusual attitude.

### Inverted Spin Recovery

Recovery from an inverted spin follows the same procedure as outlined for normal spin recovery. Get the most favorable aircraft configuration: tip tanks empty, gear and flaps retracted, ailerons neutral and throttle in idle. If fuel remains in the tip tanks, they must be jettisoned at once.

Effect the recovery by checking the throttle in idle position, holding the ailerons in neutral, bringing the stick *aft* and applying rudder pressure against the spin until rotation is stopped. When rotation is stopped, keep the stick *aft* until the nose is well down and safe flying speed is attained. Recovery in an inverted position with the stick aft may mean that at least a partial split-S will be performed.

Frequently, in an inverted spin, after the stick is brought aft and rudder is applied at the top of an oscillation, the aircraft will come over from an inverted spin into a normal, erect spin. If this happens, use the standard spin recovery.

### Out of Control

On several occasions, while running the spin tests, the T-33 has entered a violent maneuver described by the company pilots as an "out of control" condition. The gyrations are violent, erratic and do not follow any particular pattern. At first, the pilot may have considerable difficulty in keeping abreast of the changes in aircraft attitude. It can best be described as somewhere between a pitching motion and tumbling. After the aircraft has fallen about 2000 feet or more it will settle down and progress into either a normal or an inverted spin.

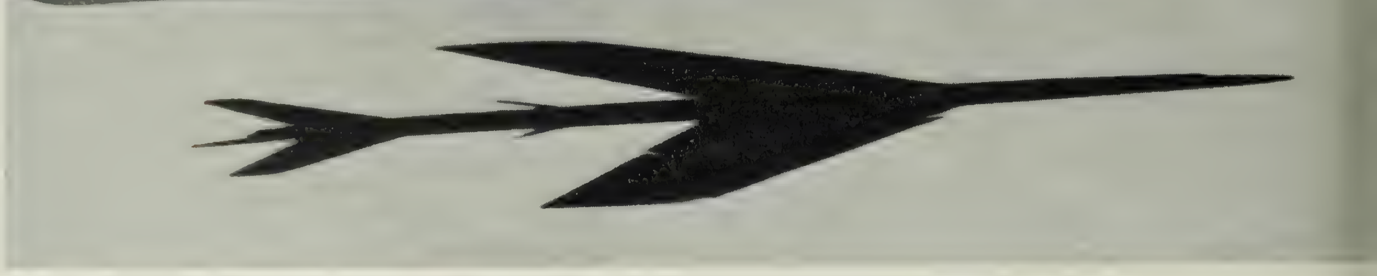
Research disclosed that the aircraft entered into this "out of control" condition out of a stall, with the gear and flaps extended. However, it has only occurred after the stall was aggravated; that it, one in which the stick is held back on the stop after the T-33 is stalled and the pilot attempted to keep the wings level.

If this condition is encountered, the pilot should immediately bring the throttle back to idle, hold the ailerons in neutral, get the stick aft and retract the gear and flaps. In other words, follow the same procedure used in a spin. After rotation has developed and the spin direction is apparent, use the rudder to stop it just as in any other spin.

A final word of advice concerns altitude. If the terrain clearance is less than 10,000 feet, it is recommended that the canopy be jettisoned. This serves a dual purpose. It is the first step toward a possible bailout, and it may assist recovery.

# LOOK BEFORE YOU LAND

**Don't become an accident statistic at the end of your journey; keep your head on a swivel and be a see-all before touchdown.**



THE tired old bleat that two is company and three is a crowd doesn't even begin to apply to that part of aviating more commonly referred to as the approach and landing. Two flying airplanes may become a good-sized crowd when one pilot or both fail to follow the cardinal rule of keeping their heads on respective swivels while bringing the old crate home to roost.

Take the recent cases of a couple of T-33 accidents at Alpha Air Force Base. Each T-33 aircraft was being flown with a student pilot in the front and an instructor pilot in the rear seat. None of the pilots involved in the accidents saw the other jet until the time of collision.

The traffic pattern in each case was flown with one plane slightly above and behind the other and, in both cases, the planes were over the runway and touching down for a landing. In each case the controller in the Mobile Control unit had seen the jet trainers in dangerous positions to each other while they were in the landing pattern.

Radio calls were transmitted for one or both of the jets to go around. However, the instructions were either not heard or the pilots failed to recognize that the radio calls were meant for them. In the first accident, a red flare was fired just as the aircraft reached the end of the runway but this warning was too late to prevent the collision that followed.

Both of these accidents could have been prevented if the number of aircraft permitted in the pattern at one time had not exceeded the number which could be safely monitored by ground traffic controllers . . . or if the pilots concerned had made that all-out effort of making *sure* they were clear before landing.

From the simon-pure pilot error standpoint, consider this F-51 accident at an overseas base. This Mustang jockey was attempting the old tactical approach with a restricted visibility of from one to two miles. Upon reaching the end of the runway, he peeled up sharply to the right, dropped flaps, and attempted to complete a tight 360-degree turn just off the end of the runway in order to be lined up for a nice, hot grease job. The plane stalled into the ground, bounced over a road, and skidded to a stop fifty yards short of the runway. This pilot's "looking around" had not included the haze that prevented his accurately lining up with the runway.

### Look Around

The final phases of approach and landing usually takes about two to three minutes. If there is restricted visibility, or if the landing is being made at night, the pilot might spend a couple of those minutes guiding the aircraft more or less on instruments to a point where adequate visual reference would indicate whether he is safe to land or go around again.

On the other hand, the looking around rule can be overdone and the pilot can become a victim of his own vigilance . . . like this B-50 pilot who completed a routine test flight and was coming in for a routine night landing.

At least that's what the pilot thought as he routinely called the tower for landing instructions. The tower came back with the poop and the pilot acknowledged the instructions and entered traffic at an indicated altitude of approximately 800 feet, about two miles out from the runway. Visibility was good and the runway was well-lighted. The checklist was run through while the B-50 was on the downwind leg and the crew got ready for landing.

As the aircraft turned base, permission to land was received from the tower with the usual gear-down-and-locked remainder. At this point, the tower also advised the pilot of a corrected altimeter setting, but neither the pilot nor copilot corrected their altimeters.

The pattern was close to the field and the base leg was just a momentary roll-out in which full flaps were started down. The turn onto final approach was made between 400 and 500 feet indicated and the B-50 continued descending at about 130 mph.

As the pilot completed the turn into final, he realized his dangerously low altitude and attempted to maneuver out of the situation too late. The left gear, nose gear and Nos. 1 and 2 engines struck a dike and the bomber skidded in a groundloop and stopped about 700 feet from the end of the runway. These pilots had apparently looked every way except down.

Because many USAF aircraft in current use have little or no rearward visibility, the pilots of such type aircraft, say, holding for clearance in takeoff position on the end of the runway, must rely almost entirely upon the tower or mobile controller as to whether or not the approach is clear of landing planes. In this situation, a hazardous condition can be created by a momentary communications failure. distraction of the tower man or other unusual condition.

### Dangerous Situation

For the pilot who is holding on the end of a runway or the jockey who is entering the traffic pattern, the tower man or runway controller has his share of the responsibility for a safe landing. The ground men must give their full attention to the taxiing and flying aircraft and maintain strict control whenever there appears to be a dangerous landing or takeoff situation developing.

Although the alert tower man can, and often does, prevent serious aircraft accidents, this does not in any way relieve the pilot of his responsibility for making proper landing and takoff checks and watching where he is going on the ground or in the air. Nor do tower instructions in any way relieve the pilot of the responsibility for using sound judgment on whether to taxi, take off, land or go around.

There are no crystal ball solutions for making all landings and takeoffs absolutely safe or solving the problems that are being brought about by an ever-increasing amount of air traffic. The weather factor and Air Traffic Control problems on IFR flights are being solved in part through better radar equipment and procedures.

It's up to the pilot, when it's CAVU to use his head and eyes and be sure the way is clear for a safe touchdown.

### TRAFFIC PATTERNS

Even under the most favorable conditions, the most hazardous moments of any flight are at its beginning and end . . . the takeoff and landing. At these extremities of flight, the aircraft's altitude is lowest while at the same time the airspeed is close to the stalling point, a combination that leaves a pilot no time for recovery or maneuvering.

A goodly percentage of all USAF accidents occur during this phase of flight and only constant vigilance on the part of the pilot will help reduce the landing accident figures to a minimum. Here is how you can help by following good landing rules:

- *Initial checkout*—Complete orientation of pilot on aircraft landing characteristics and performance.
- *Cockpit checks*—Pilot must establish and know a definite procedure for each aircraft in which he is current.
- *Approach speed*—Maintain proper speed during all phases of landing pattern.
- *Gear and flaps*—Make complete gear and flap check.
- *Runway alignment*—Make sure the alignment is accurate.
- *Radio watch*—Listen to the tower . . . there may be a plane you *can't* see.
- *Pattern*—Fly the correct pattern procedure and look around.

# ...FIT TO BE TIED

The protective helmet, if properly fitted and worn, can mean the difference between a slight headache and possible injury – the smart pilot makes sure his helmet fits.

### By 1st Lt. William A. Johnston, Safety Education Division, D/FSR.

THERE'S a story they tell about the confirmed gambler, who, night after night, lost all of his money in a crooked gambling joint. One night, after dropping a month's pay, the gambler's friend asked:

"Why do you keep gambling in this joint? You know the place is dishonest.

"I know," replied the gambler, "but it's the only place in town." Smart gamblers, however, never play unless the odds are right.

It's a well-known fact that most Americans are gamblers by nature, and some of them have been known to gamble with their lives.

Speaking of odds, do you know that your chances of having a protective helmet (hard hat), that fits you properly are 100 to 1 against, poor odds in any game . . . if you can look at today's kind of flying as a game . . . and it's closer to being a cold, hard science.

Inspection teams from the Aero Med Laboratory have visited six bases in the past few months, and have found few P-3 helmets that are properly fitted or worn. The team has listened to complaint after complaint about how poorly the helmets fit, how heavy the visor is, how vision is impaired, etc.

Most of the complaints are justified, but usually they're soon rectified by proper fitting of the complainant's helmet, and proper installation of the visor mechanism. Adequate instructions to personal equipment personnel are to be found in two Tech Orders—13-1-37 for the helmet, and 13-1-40 for the visor.

*There's a good checklist recommended for use in T. O. 13-1-37, "Use and Maintenance of Type P-3 Flying Helmet," which states, in substance:*

*"It is the responsibility of using personnel to visually check, prior to flight:*

- ★ *All lacing cords of the sling assembly to see that they are sufficiently taut.*
- ★ *All knots to see that they are securely tied with a SQUARE knot to prevent any slippage.*
- ★ *The oxygen mask to insure that it is properly attached and fitted.*
- ★ *The visor mechanism to insure that it functions properly and that the lens is not scratched to the extent that vision is impaired."*

★ ★ ★ ★

*All using personnel should check T. O. 13-1-37 personally, for, while it is the responsibility of personal equipment personnel to properly fit the helmet, every pilot owes it to himself to see that his helmet fits properly.*

*In order to clear up a great deal of confusion about the nomenclature of the various helmets in use, all using personnel should read T. O. 13-1-38, "Modification of Protective Flying Helmet, Type P-1."*

*Basically, the P-3 helmet is the P-1 helmet, with a serious of modifications, and by reading the T. O.'s, a pilot can determine the major differences between the three helmets—the P-1, the P-1A, and the P-3.*

*Proper installation instructions for mounting the visor mechanism to the P-1A helmet may be found in T. O. 13-1-40, which is contained only in the modification kit. Care should be taken to insure that the visor mechanism is properly installed for the ultimate in emergency protection.*

It would appear logical that a pilot should check the T. O.'s to see to it that the helmet, which may save his life, has been properly adjusted and modified to do the job it was designed to do. And yet, most pilots interviewed on the trips have displayed complete ignorance, and sometimes indifference, to the proper fitting and wearing of the protective device.

#### Excuses, Excuses!

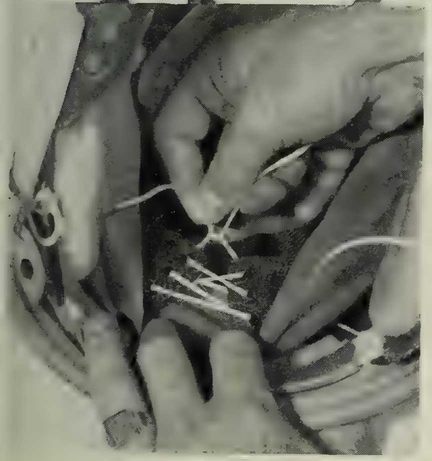
Excuses are many, and in some instances, justified. The major complaint appears to be that rapid personnel turnover does not permit competent personal equipment people to stay on the job long enough to learn the business. If that's the case, and it seems to be, the pilot owes it to himself to read the tech orders, and if necessary, to fit himself or at least insure that his unit's personal equipment specialist does the job properly.

Another major complaint received from the field is that neither helmets nor the visor attachments are available. This fact is admitted, but supply is expected to meet demand soon. Until that time, stop-gap measures should be taken. An old battered helmet, properly fitted, is better than a hole in the head—and that's no joke, son!

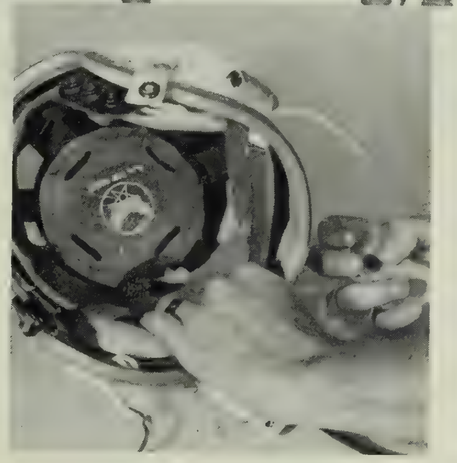
Speaking of holes in the head—prevention of these holes is the main purpose of the "hard hats." The helmets are not intended to be crash helmets. Rather, they are meant to offer a reasonable amount of protection during emergency operations when a head can be buffeted about considerably moreso than somewhat.

For example, motion pictures taken of an actual ejection show that the head is subjected to a violent snap forward as soon as the seat leaves the tracks—and then—just as violently,

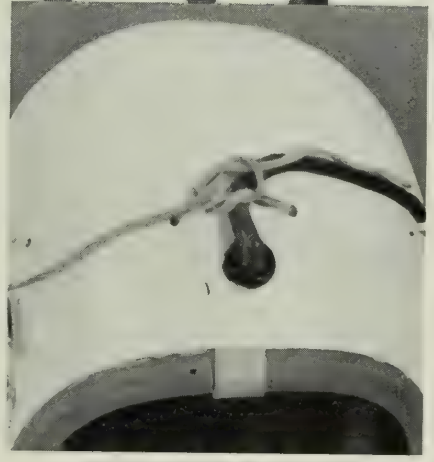
odds are extremely high that
e of these helmets properly fit.



Before attempting to fit the helmet, the headband should be let out.

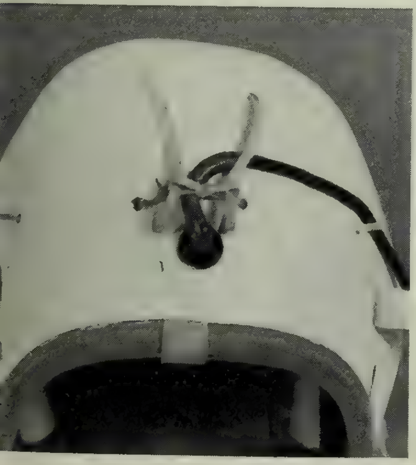


The shell lacing does not control head size but must be as tight as is possible.

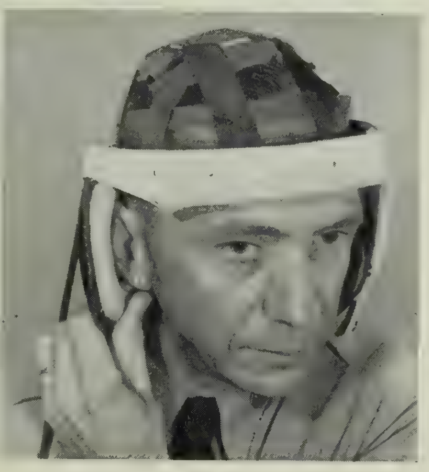


After tightening, lacing should be secured around cord with a square knot.

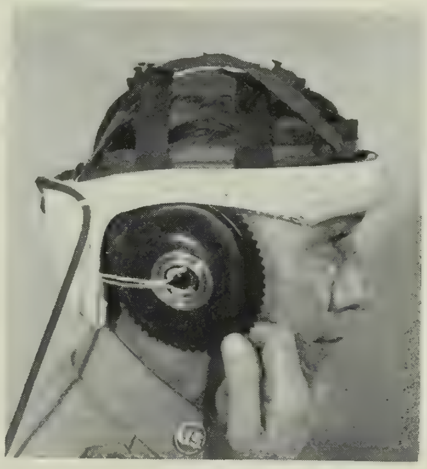
After knotting, tie each end of the lacing in a half hitch around the cord.



Earphone mounting pads should be adjusted to touch the lobes of the ears.



Radial webs of the top sling should be straight and entirely free of wrinkles.



**Headband should be taken up slowly, trying on helmet after each change.**

**Foam rubber pads insure comfort; eliminate most external noises.**

**Full rubber pads should be spot-cemented in the earphone mounting.**

snapped backwards, where contact is made with the headrest.

### Odds Aren't Good

If the pilot loses his helmet as soon as he jettisons the canopy, the contact with the headrest could cause unconsciousness, and while some pilots have been known to unfasten the seat and pull the "D" ring while unconscious, the odds aren't too good that Mr. Average Pilot will make it.

Once again, it all reverts back to a proper fit, and proper installation of the visor mechanism. The visor was designed to prevent the loss of the helmet during high speed ejection. And, tests have been made which prove that the helmet will stay on at speeds up to 600 mph.

There seems to be some confusion as to the designation of the various helmets in use today. The P-3 helmet is a modification of the P-1 and P-1A helmets as follows:

The P-1 helmet was originally modified to include a neckstrap, revised and strengthened oxygen mask assembly tabs, and other minor changes. This was designated the P-1A. The P-1A has been modified to add an anti-blast visor and assembly to prevent loss of the helmet and oxygen mask during high speed bailouts or ejections, and called the P-3.

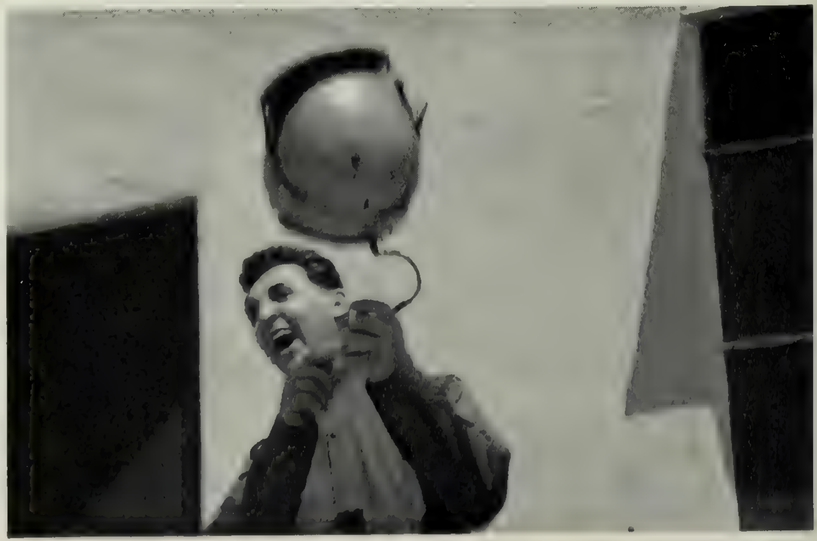
The rigid outer shell of the P-3 helmet is molded and laminated for strength. An inner sling assembly provides a means of adjusting the helmet to different head sizes, and sponge rubber pads regulate the pressure placed on the head and ears by the earphones. When worn properly, the weight of the helmet should be distributed between the top sling and the head band.

Fasteners are installed on either side of the ear tabs for attaching the oxygen mask. Wiring for the microphone and earphones is integrated in one cable which enters the back of the helmet. The microphone jack on the lower left side of the helmet makes it unnecessary to disconnect the oxygen mask microphone plug during bailout. The visor mechanism restricts the rush of air into the helmet from the front, reducing the chance of losing the helmet and mask during bailout or ejection. It also affords glare protection and protection to the face from flash fires within the cockpit.

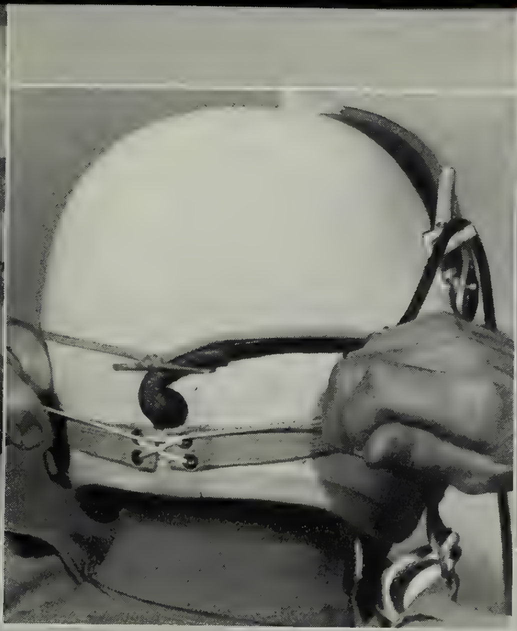
### Check It Over

There's a pretty good checklist that can be used before embarking on a flight when a helmet is worn:

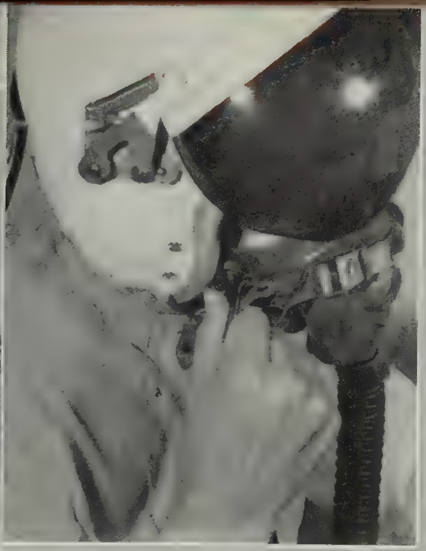
**. . . Don't make like a yo-yo with the communication cord!**



**xygen mask should be attached to e helmet by brass machine screws.**



**Neck strap lacing should be tightened until strap just touches back of neck.**



**This is proper grip for removing mask. The clasp works easily after you practice a few times.**

- Are all lacing cords adjusted orrectly and taut, secured with square nots and half-hitches?

- Is the oxygen mask fastened ecurely to the helmet oxygen mask abs? The left side should be secured vith button fasteners plus screws. The ight side should be fastened with the ook assembly, which in turn is astened to the right oxygen mask abs with button fasteners plus crews.

- Does visor assembly function roperly and easily, both up and own, and does it lock in place when owered?

- Is visor lens free from dirt and scratches which might affect clear vision?

In addition to the preflight checklist, there is a series of everyday do's and don'ts, which every pilot should be acquainted with:

- Don't object if you find it difficult to get your oxygen mask off after a flight. It is far more important to have it stay on in a wind blast than it is to have it come off easily after you are safely on the ground. *Your mask can be unhooked with one hand after practice.*

- Unless it is absolutely necessary, don't let others borrow your helmet. It should be fitted to *your* head. If it is, it probably won't fit anyone else properly without changing the harness assembly.

- Don't throw your helmet in a locker, or in the corner of your room, and don't put it down on the visor.

- Don't spread your helmet unnecessarily when putting it on, or you will alter the shape and fit.

- Don't use a helmet that does not fit properly.

- Don't let the communication cord dangle and flop about, or carry your helmet by the communication cord. You may kink or break the communication lines.

- Fasten the throat strap and carry your helmet like a market basket or tuck it under your arm.

- Always place the canvas cover over the visor when not using the helmet.

- Hang up your helmet by the throat strap or place it upright on a shelf.

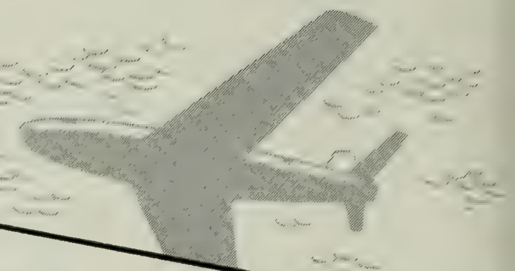
- Thread the communication cord behind the shell lacing to prevent the cord from flexing and kinking.

- Be sure of a correct fit.

- Take good care of your helmet.

- Read T. O. 13-1-37 which tells you how to get a correct fit for your P-3 helmet, and T. O. 13-1-40 which tells you how the visor mechanism should be attached to the helmet.

**. . . Take good care of your helmet. Don't be sorry!**



# SELBY says:

## slant range visibility is essential!

*Another Point of No Return . . .* This incident happened in the Great Lakes region, not too long ago. I am sure that it broadened considerably the education of the F-86 pilot, and I am also sure that he is more confused than ever on the inability of weathermen to give him accurate reports for landings during bad weather.

Here is the story as the pilot related it to me.

"I was flying on top at 35,000 feet, enjoying the bright winter moonlight and the ease with which I was skipping across the milky white cloud deck. Below the cloud deck, I had been briefed by the weather people that the ceiling would remain at about 2000 feet, with visibility dropping to three miles in light snow flurries. I figured a penetration of the cloud deck, and then a GCA pattern into the field was just SOP.

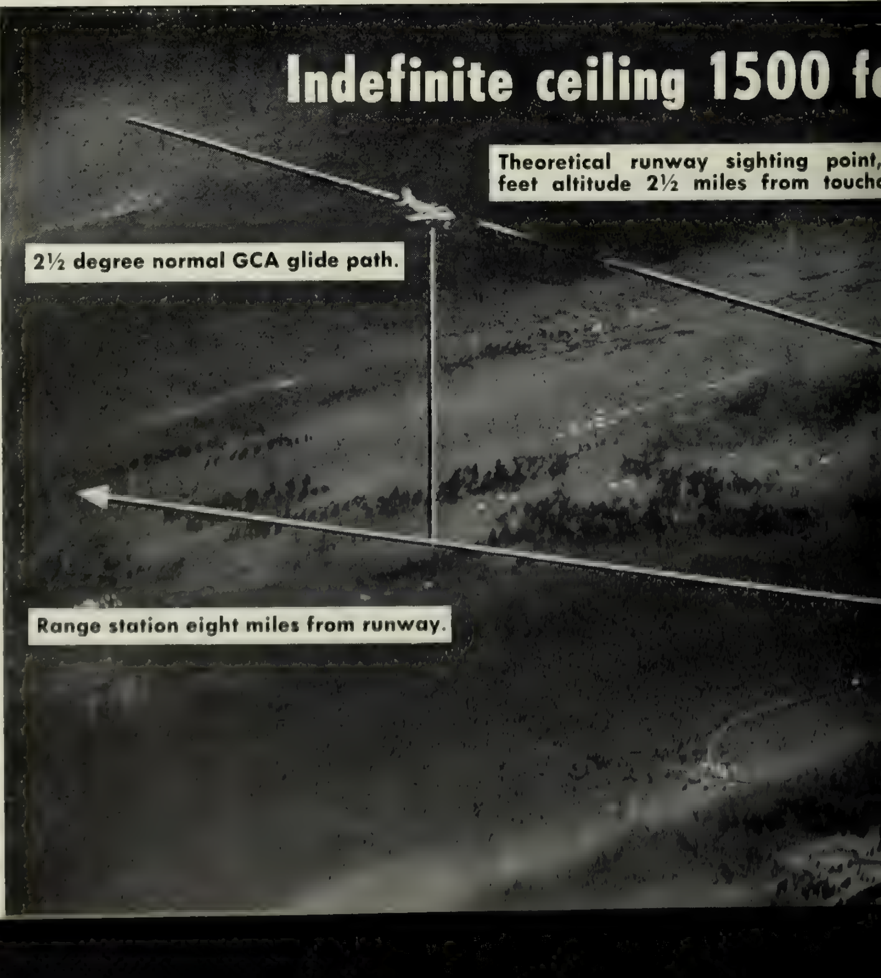
"Just to be sure, I called for the latest weather condition and was told that there was an indefinite ceiling, 1500 feet, obscured, with 2½ miles visibility in light snow. This caused me no sweat; it was well within my know-how and I had made many a landing under worse conditions. That is my busines. In the All-Weather Interceptor squadrons we expect to fly in severe weather and the report just made me relax.

"I also obtained the weather for the alternate which was within 80 miles of my home station, just in case the weather closed in, but now I was all set. By the way, the alternate weather was a measured ceiling of 4500 feet, with visibility of more than 15 miles, and I had more than enough fuel to go to the alternate. I wasn't cocky about this landing, but later events showed that I had a lot to learn. When I committed myself to landing at the home station and found that the conditions were not as reported to me, I didn't have enough fuel to climb out and proceed to the alternate that was 80 miles away. Jets are peculiar machines. They get you there in a hurry, but they don't give you the fuel cushion that we used to have in our old type fighters.

### Everything Normal

"I let down through the cloud deck on an unrestricted letdown clearance to the range station — eight miles from home, figuring on a cocktail at the Officers' Club with my friends, and a good steak dinner with the family.

"I passed over the range station at 2500 feet and was picked up by GCI. Everything was normal and I told the controllers that I had the runway in sight. I should correct that and state that I *thought* I had the runway in sight. It was snowing


Indefinite ceiling 1500 f
Theoretical runway sighting point, feet altitude 2½ miles from touch
2½ degree normal GCA glide path.
Range station eight miles from runway.

**The perspective drawing at the right shows the approximate flight glide paths and altitudes of two jets whose pilots followed missed approach procedures when windshield plus ambient obscurations prevented sighting of the runway until it was too late to land.**

and, as you know, a little wet snow bouncing off a jet windshield, looks like a lot of snow. GCI directed me down the glide path and at 300 feet altitude, I asked them to 'Please turn on the high intensity runway lights.' They came back immediately and seemed surprised. They said the lights had been on all the time and I must have seen them when I reported that I could see the runway over the range station.

"At 300 feet, I was below the authorized minimums for the airfield and believe me, I hit the panic button! I felt like the guy who flew up a blind canyon. I climbed out on a missed approach procedure and did a lot of squawking to tell them what I thought of that weather report. All the time I was reporting, I kept thinking of that fine alternate only 80 miles away, with a 4500-foot ceiling and 15 miles visibility. Apparently, I wasn't going to enjoy that cocktail in the Officers' Club, or that good steak dinner.

"It takes time to make a precision instrument approach and I knew that I would run out of fuel before I could complete another. There was only one thing to do—leave this fine piece of machinery that my country had entrusted to me and hit the silk —with the hope that they wouldn't also lose the big training investment in me!

"I am still a little confused. I looked at this instrument approach from all angles and I think I did the right thing. It never occurred to me that maybe the weatherman might make a mistake, or that he was just guessing at those weather conditions when I decided *not* to use the open alternate.

"I guess that I am just an overly trustful jockey."

*Brother, this weatherman didn't make a mistake, or give you wrong information. You went through an experience that is more common in the flying game than it should be.* (Another F-86 pilot stated that he got a glimpse of the runway at one-quarter mile but couldn't land. He was more fortunate and had reserve fuel to go to the alternate.)

### Weather Limitations

The United States Weather Bureau and the military weather sections have recognized their limitations in accurately measuring obscured ceilings occasioned by snow, rain, dust and haze. Without doubt, the American weather people are the best in the world, but they do not have a method or technique that will give them precise and accurate measurement of obscured ceilings. Air transportation is only 30 years old and the jet age is only five years young. Great progress has been made in all fields of aviation, but we have a long way to go to solve all of our problems.

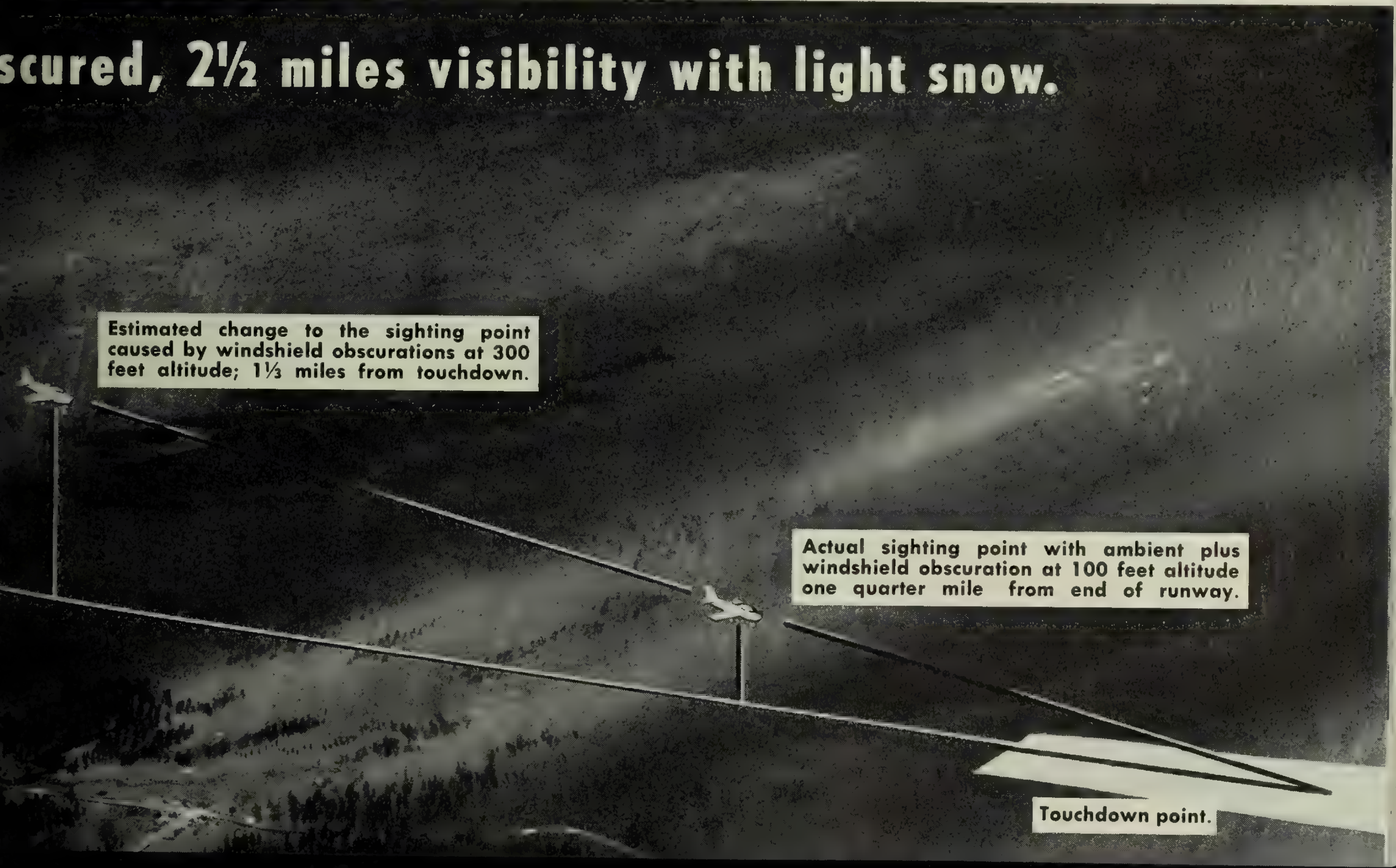
All pilots, commercial and military, would welcome an accurate measurement of obscured ceilings, especially at low altitude—with ceiling measurements made on the approach to the active runway in the airspace containing the final approach glide path. The pilot wants to know at what altitude and at what distance from the touchdown point on the runway he can transition from instruments to visual reference. To our knowledge, there is no blind landing system in existence in the world.

Precise and accurate measuring of obscured ceilings are lacking in not only the Air Force, but in commercial air operations. Obscured ceilings at moderate altitudes pose no landing problem; however, the absence of precise measurement when the ground is obscured to a pilot at low altitude, is extremely hazardous.

Invariably, high intensity ceilometers or light beams and weather balloons used for determination of these obscured ceilings are taken in the vicinity of the airfield weather section, located near the terminal or operations building. It is the consensus that ceilings must be most accurately measured in the airspace containing the final approach glide path.

### Ceiling Defined

Both the Air Force and Civil Aeronautics Board have identical defini-



**scured, 2½ miles visibility with light snow.**

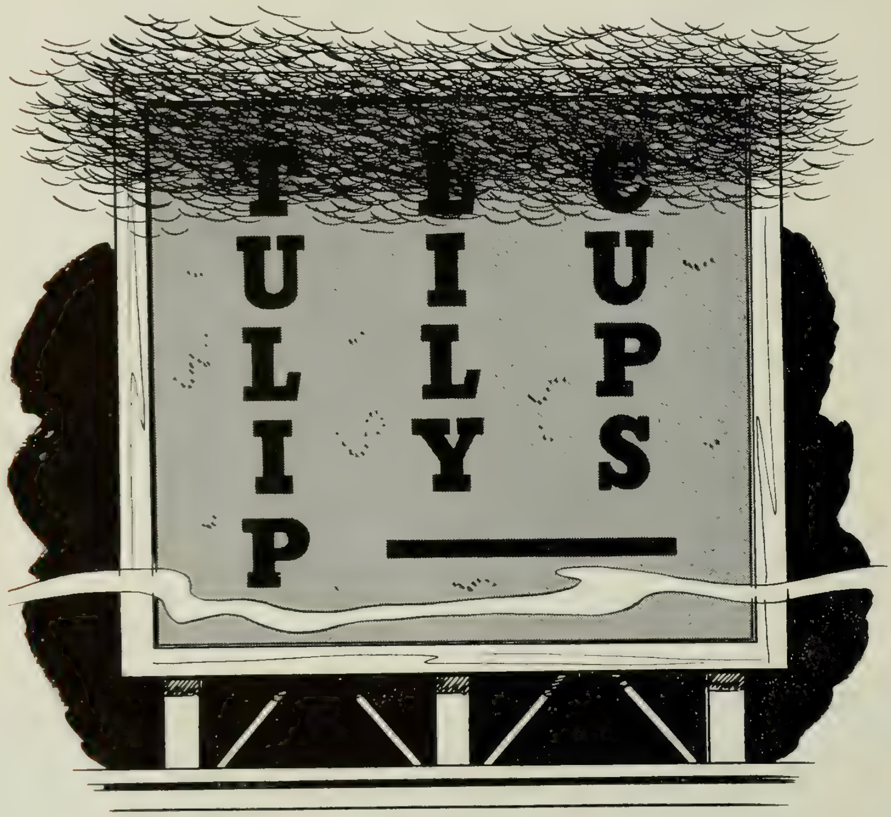
Estimated change to the sighting point caused by windshield obscurations at 300 feet altitude; 1⅓ miles from touchdown.

Actual sighting point with ambient plus windshield obscuration at 100 feet altitude one quarter mile from end of runway.

Touchdown point.

tions for the word "ceiling." Airfield weather sections can accurately measure well-defined cloud decks but cannot, with present techniques and equipment, accurately measure the indefinite or precipitation ceiling from which a pilot in flight can see the ground during conditions of P (precipitation) or W (dust, haze, fog, etc.)

Under conditions of a P or W ceiling, airfield weather observers estimate the height of the obscured ceiling by using as a guide the upper limit of a high intensity ceiliometer reaction, the top of a ceiling-light projector beam, or the height at which a balloon completely disappears. The meaning of the term "indefinite ceiling" is clear to skilled weathermen; however, the F-86 pilot in this accident assumed that the indefinite ceiling of 1500 feet obscured would pose no particular problem. The phrasing used, "Indefinite ceiling—precipitation ceiling, obscured." can mean many things to the pilot and usually does not have the same meaning to him as it does to the skilled weatherman. The pilot thought he could see the runway from 2500 feet and called for runway lights at 300 to 400 feet altitude. The high intensity runway lights were on at the time and the pilot could not see them.



*The pilot's angular vision from the cockpit, through the windshield, or over the side of the fuselage, is a slant range of sight.* The human sight capability is not identical to, nor comparable with, ceiliometer reactions, light projector beams, or the height at which a balloon completely disappears to the vision of a ground observer. These last-minute terminal weather conditions are given to the pilot for the purpose of accomplishing a safe landing. They might be in error, as they were in this case, *from the pilot's position in the cockpit*, by as much as 2000 feet altitude.

Therefore, the ceiling weather observations given to a pilot for a landing under conditions of obscuration phenomena are of questionable value. At low altitudes, obscured ceilings must be accurately measured and not estimated. Solution to the problem of precise measurement of obscured ceilings at low altitudes is very important in landing aircraft under adverse weather conditions with reasonable safety.

*The visual problem due to obscuration phenomena is further complicated by rain or wet snow on the windshield. This rain or snow will add another factor of obscuration to the ambient weather condition and will also introduce windshield distortion.*

The CAA and other research organizations are working on the problem through windshield design and are also testing the effectiveness of windshield anti-wetting agents. Preliminary reports indicate that the anti-wetting agent is effective with rainfall rates up to 2″ to 3″ per hour.

The finest research brains in the world are working around the clock to maintain the American airpower position—both civil and military. *Someone will come up with the answer because a nation that can produce the atomic bomb can certainly solve this little problem for the pilot.*

Our old airline pilots with many thousands of hours in air carrier operations, have learned the hard way. Through experience, they have learned that they must carefully interpret the weather terminology used by the weatherman and they know that the weather observations given to them in flight may change drastically in 30 seconds when an obscured ceiling is present. This problem has existed for the airman since he flew the first airplane across the United States.

*Until the solution is forthcoming, all pilots must recognize the limitations of our weather techniques and act accordingly.* This is more important to the jet pilot than it is to the commercial transport pilot who still flies the reciprocating engine and has a large cushion of reserve fuel for all contingencies.

For years, commercial transport pilots out of La Guardia have been using the *"TULIP LILY CUPS"* billboard sign for ready reference on slant range visibility and ceiling. When the sign said, *"ULIP ILY UPS,"* the ceiling was below 300′ and safe minimums.

*We wonder!—do they still use this sign for their best weather reference?*

Selby

# tell the WHOLE story

HOW MANY OF YOU pilots would fly for hours and forget to log the time?

The Form *1* is a record of your flying time; it is usually filled out with meticulous care, each minute is pampered and sometimes promoted to five; unfortunately, its kid brother, the 1A, doesn't fare so well.

Imagine the problem presented by *each* "remark" you make in the Form *1A*. Remember this:

Out of the few words you pencil in the form, maintenance must create a safe airplane, not one that is temporarily fixed but one that is cured. Fortunately in many cases the trouble is accurately diagnosed and corrected, whether the Form *1A* was helpful or not. But sometimes the trouble is unknown or so poorly described that the write-up is meaningless.

Some typical "write-ups" are—

- Engine seems rough at 500 feet. O.K. elsewhere.
- Manifold pressure decreases as altitude increases.
- Engine cut out twice in cruise, flew O.K. two hours after that.
- Radio and instruments inoperative when battery switch is turned off while taxiing—must be a short somewhere.
- Prop ran away on takeoff.
- Check for vibration.
- Check for high M.P. on left engine.

Reading between the lines of such "squawks," like the mechanic, you will suspect things. You will have questions but the guy who wrote them, too often, has gone. How much did the prop run away? What RPM? How high did the manifold pressure go? Where was the vibration? How long did it last? Did you notice the fuel pressure when that engine "cut twice?" Were you switching tanks at the time or changing any settings? What do you mean by "seems rough?" Did you check mags or change mixture? If so, what happened?

When you lose an engine it's P.T.M. (props, throttle, mixture). *How about a checklist* of the Form *1A?*

- Put down all you know about trouble experienced. Don't guess.
- Tell the crew chief or engineering officer about all the other little details if they are too numerous to mention.
- Most important of all, don't forget the Form *1A*. Enter your flight as O.K., or put down your remarks on those things that you object to.

Use this checklist after each flight is completed. It will make the aircraft safer for the next pilot, who may be *you*. And the crew chief will greet you with a smile when you come out to fly his ship. ●

# Keep Current

NEWS AND VIEWS

## Crescent Wing Design

The goal of aircraft designers is to evolve the ideal aircraft for high altitude, supersonic flight, with safe control near the ground. According to C. S. Stafford, chief designer for Handley-Page Ltd., the crescent wing design achieves this objective.

The essence of the problem has been wing drag. As the main drag comes from the wing, the solution lies in the design of a wing with low drag at high speed. With speeds in the past well below that of sound, the forces on an aircraft were directly related to airspeed. On approaching the speed of sound, air compressibility causes a rapid increase in drag. Since air must go faster in following the shape of a wing or fuselage, there will be many regions on the aircraft where air velocity will be greater than flight speed.

Apart from their influence on drag, shock waves affect control, stability and flutter and that is why the shape of a long-range, high-speed aircraft must be determined with greatest care. Even small regions causing shock waves mean large increases in drag. Naturally, the speed at which this sudden drag-rise occurs must be higher than the intended cruising speed.

Low drag, good control qualities and stability and freedom from flutter or divergence are essential for the highspeed aircraft. Additionally, it must be controllable and stable at the stall in order to land at reasonable speed with safety in the hands of a pilot of normal skill. Also, we must have structural lightness with strength and stiffness and, ideally, a wing must be thick enough to house engines, undercarriage and fuel.

How are we to fly at high subsonic speeds at great height and with the aircraft under control near the ground? Wing sweep is the partial answer. It is the recipe for the delay of compressibility-drag. High subsonic speed with low drag is attainable with wings that are straight-swept either backward or forward or with razor-thin unswept wings. These are, however, serious shortcomings with straight-swept wings in that large sweep-angle cannot be used except at very low aspect ratio owing to poor stalling qualities.

The back-swept crescent wing, with angle of sweep progressively decreased towards the tip, permits the use of high aspect ratio for good altitude performance with good stall characteristics. To analyze the problem, why have sweep at all? Why not a simple straight wing?

To avoid compressibility-effects a straight unswept wing must be very thin indeed. It could be built in this way, but a bomber would look like a Christmas tree with engines and fuel tanks hanging from the wing and the undercarriage would take up useful space in the fuselage.

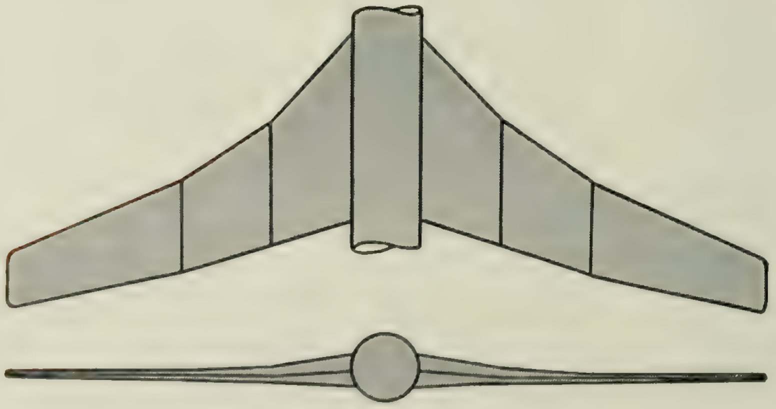
Air flowing over straight-swept wings is deflected outwards if wings sweep back. If the wing has a high aspect ratio, this air builds up at the tip when the wing is near the stalling point. The tip stalls and the aircraft becomes unstable and maximum usable lift is not as great as we want. The crescent wing, with its tip only slightly swept, avoids these snags, says Stafford.

Objections to the straight-swept wing of high aspect ratio are reinforced by bad aero-elastic qualities. Movement of the ailerons tends to twist the wing so that the change of its lift opposes the control force due to aileron deflection and so reduces lateral control. Again, if a straight-swept wing twists under air load the aircraft may become dynamically unstable. The crescent wing meets this difficulty by having a tip only slightly swept so that aero-elastic troubles are greatly reduced.

Unlike the crescent, the swept wing of low aspect ratio suffers from having a poor performance at high altitudes, the induced drag being high. If the aircraft is to operate at high altitudes, span (and hence wing area) must be large with corresponding penalties in drag and weight. Engine tail pipes must be long and inefficient. The center of gravity can only be moved between narrow limits. In order to take off or land at a reasonable speed, the pilot must fly at an unusual angle, greatest lift being obtained only at high angles of attack.

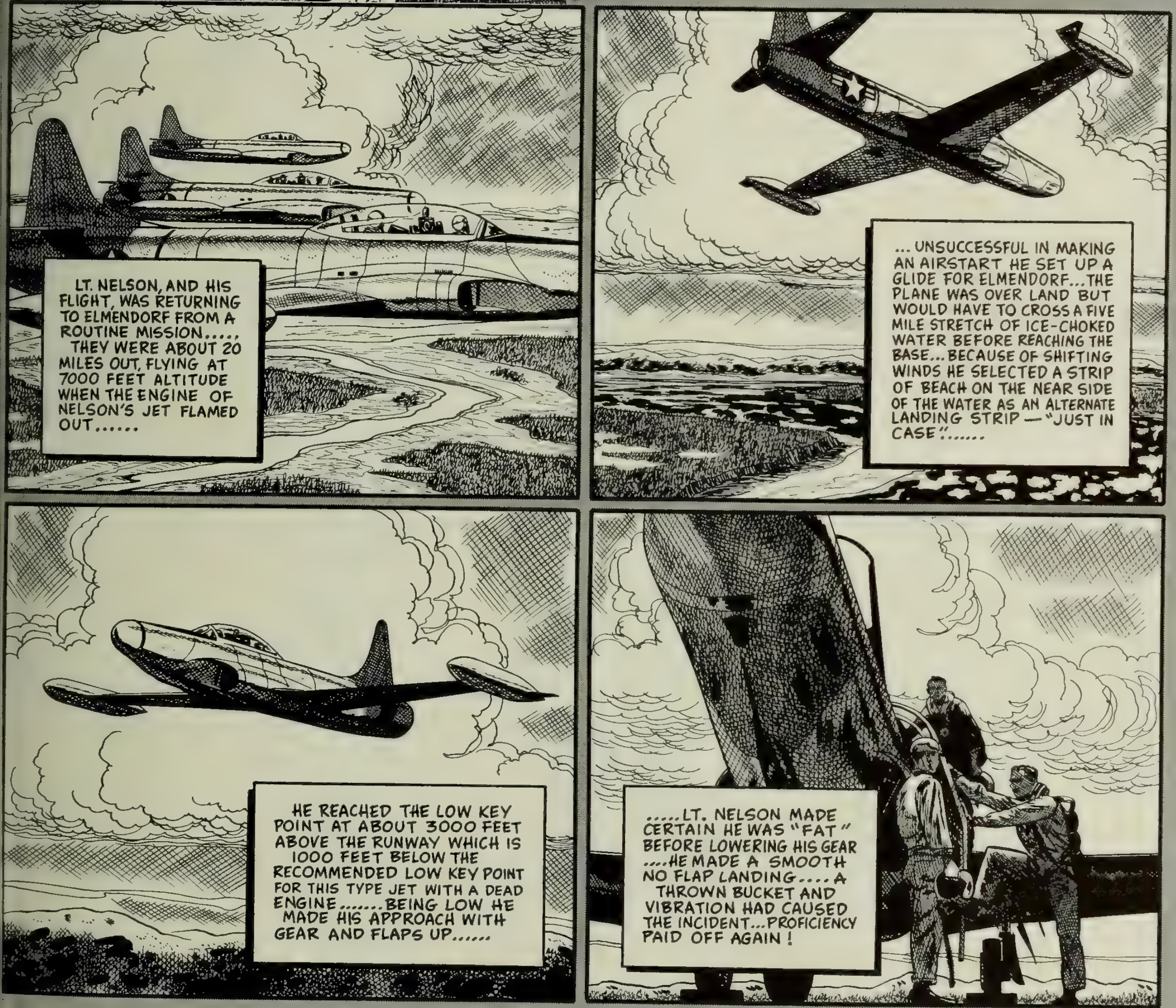
With the crescent wing, engines and landing gear are enclosed in a light efficient structure. Its large center-wing sweep enables a fuselage bomb bay to be unobstructed as the main load-bearing wing structure is well forward. Behind this, the landing gear can be folded away and engines can be buried. They are accessible without weight penalty as no cutouts are needed in primary members. With the main structure ahead of the fire zone, the chance of an engine fire being fatal is remote.

*(Shell Aviation News)*



# WELL DONE!

ARE YOU prepared for a flameout landing? Lt. S. H. Nelson of the 64th Fighter Interceptor Squadron was. The article "Project Flameout" appeared in the August, 1951, issue of *Flying Safety*, and Lt. Nelson was an avid reader. Several times he practiced landings as prescribed in the article and when an emergency arose he was prepared. . . .


LT. NELSON, AND HIS FLIGHT, WAS RETURNING TO ELMENDORF FROM A ROUTINE MISSION..... THEY WERE ABOUT 20 MILES OUT, FLYING AT 7000 FEET ALTITUDE WHEN THE ENGINE OF NELSON'S JET FLAMED OUT......
... UNSUCCESSFUL IN MAKING AN AIRSTART HE SET UP A GLIDE FOR ELMENDORF... THE PLANE WAS OVER LAND BUT WOULD HAVE TO CROSS A FIVE MILE STRETCH OF ICE-CHOKED WATER BEFORE REACHING THE BASE... BECAUSE OF SHIFTING WINDS HE SELECTED A STRIP OF BEACH ON THE NEAR SIDE OF THE WATER AS AN ALTERNATE LANDING STRIP — "JUST IN CASE"......
HE REACHED THE LOW KEY POINT AT ABOUT 3000 FEET ABOVE THE RUNWAY WHICH IS 1000 FEET BELOW THE RECOMMENDED LOW KEY POINT FOR THIS TYPE JET WITH A DEAD ENGINE...... BEING LOW HE MADE HIS APPROACH WITH GEAR AND FLAPS UP......
.....LT. NELSON MADE CERTAIN HE WAS "FAT" BEFORE LOWERING HIS GEAR ....HE MADE A SMOOTH NO FLAP LANDING.... A THROWN BUCKET AND VIBRATION HAD CAUSED THE INCIDENT... PROFICIENCY PAID OFF AGAIN !

# Cross Feed

## flying safety idea exchange

### Blanking of UHF Radio Signals

The attention of pilots is invited to the fact that they may experience blankingout of UHF radio signals when the fuselage and/or wings of the aircraft come between the aircraft antenna and the ground station or other aircraft which they wish to contact.

Pilots should become familiar with the radio characteristics of their aircraft so as to be able to avoid this difficulty.

**Lt. Col. W. V. Jacobsen**
**ADC Branch, OR&TI Div.**
**Office of the Inspector**
**General, USAF**

### Cheney Award

While reading the account of the presentation of the Cheney Award to Capt. Daniel J. Miller, and the Roster of Award winners (Flying Safety, Jan. 1953), I find an error which should be corrected.

In 1936, Maj. Frederick D. Lynch *AND* M/Sgt Joseph Murray were awarded the Cheney Award (double award for 1936).

Major Lynch was in Flight C, 16th Obs. Sq., and M/Sgt Murray was in the First Balloon Sq. Both were in a free balloon of which Murray was the pilot. The ballon crashed and burned; both men were active in trying to rescue the two men who did not get out of the crash and resultant fire. Both Major Lynch and M/Sgt Murray were awarded the Cheney Award, and Sgt. Murray was awarded the Soldier's Medal in addition to the Cheney Award.

President Roosevelt made the presentation with General Marshall.

**M/Sgt. Richard G. Leonard**
**AFROTC Det. No. 455**
**Montana State University**
**Missoula, Montana**

*(Thank you for the information about M/Sgt Joseph Murray.—Ed.)*

### Bouquet from Denmark

A few days ago I had an opportunity to read a copy of your excellent magazine, "Flying Safety." It was a real pleasure because it was very interesting. We have a flying club here in Copenhagen: The Copenhagen Airplane-spotting Club. I am the president. I showed the magazine to some of the members. They were happy, too, to read it. Therefore, I ask you if it is possible for you to send a copy to us from now on. We will be very happy to have it—if it is possible. I am waiting to hear from you with good or bad news, and in the meantime, I will say

**Sincerely,**
**Wilhelm Jorgen Jensen**
**President**
**Copenhagen Airplane Club**
**15 Oster Farimagsstreet**
**Copenhagen K, Denmark**

### That Belt Again

I am writing to you in reference to "That Belt Again" in Crossfeed, February issue of Flying Safety. I quote Ed. Note: "Captain Slater is correct, except for the correct TO reference, which should be Section 1 AN 01-75FC-1 Unquote."

Does Flying Safety magazine publish its own Technical Orders now? The reason I ask is because the T. O. you quote is not listed in T. O. 00-1-1. According to the index, the Captain has the proper T. O. listed for T-33 and TF-80 type aircraft.

If the Safety belt does what was written in Crossfeed, November issue, it must be highly educated.

You have a fine magazine and I would like to see it stay that way. No more phoney Technical Orders Please. . . .

**M/Sgt. James J. McCann**
**58th Air Rescue Sqdn.**
**APO 231, N.Y., N.Y.**

*Ed Note: You are right! Captain Slater was correct in his T. O. reference. Thanks for your interest.*

### Likes Magazine

Flying Safety continues to improve with each issue. The stories seem to be written with an expert hand, by people who know what they're talking about. I think your issue on Weather is one of the best issues of its kind I have ever seen, and I have been reading Flying Safety for many years.

**Maj. George Spelvin, USAF,**
**APO 231, New York, N. Y.**

Hero pilot reports was half-way through split-ess when capitalistic sabre-jet hit him, causing tail damage!

# the form 1-a for tennis

*A flying man wouldn't have any gripes at all to write up after an A-1 date for tennis. He could remember everything in vivid detail. Why not keep the same attitude toward your job as a pilot in the USAF . . . if you have squawks after a flight, write them up on the Form 1-A . . . explain what, where, why, and when something went wrong. It will make the airplane safer for the next pilot who may be YOU!*

**Use a Form 1-A Checklist After Each Flight**

A CORDAY, *Atlantic Productions*

# AO . . . CHECK RAMPS AND RUNWAYS NIGHTLY

THE airdrome officer represents the base commander and the operations officer in all matters pertaining to flight of aircraft. His duties consist of more than checking clearance forms, if he is to do his job right.

It is important that the airdrome officer check ramps and runways each night to check adequacy of facilities, freedom from congestion, and the possibility of dangerous obstructions in the form of parked vehicles or equipment.

A careful check of airfield lighting should also be made, and inoperative lights should be reported at once to the Control Tower and to the Installations Officer.

**LOOK SMART—BE SMART—FLY SMART THROUGH FLYING SAFETY**

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# FLYING SAFETY

UNITED STATES AIR FORCE

**Base Flying Safety and YOU**

. . see page 10

OFF WE GO...
...INTO THE WILD BLUE YONDER....

# WHAT'S WRONG HERE?

AFR 60-15 says, and we quote, "The landing gear will be actuated *only* by a rated pilot performing *first pilot* or *copilot* duties. The copilot will actuate the landing gear controls *only* when specifically directed to do so by the first pilot."

Too many landing gears have been prematurely retracted by a zealous crew chief, or by a copilot who failed to wait for the pilot's signal . . . which will be given *verbally* and by *hand signal* by the first pilot.

The regulation also states that the instructions given by the pilot will be repeated by the crew members receiving the command, before execution of the command is begun.

**KNOW YOUR OPERATING REGULATIONS...PLAY IT SAFE!**

Department of the Air Force
The Inspector General USAF
lajor General Victor E. Bertrandias,
Deputy Inspector General

★ ★ ★

igadier General Richard J. O'Keefe
Director
irectorate of Flight Safety Research
Norton Air Force Base, California

★ ★ ★

Colonel John R. Dahlstrom
Supervisor of Flight Safety
Publications

★ ★ ★

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★ ★ ★

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VOLUME NINE
NUMBER SIX

# FLYING SAFETY

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Under the hood for practice—see p. 16.

Chow time for two survival trainees.

# Survival in the TROPICS

A fire is of special importance in the tropics. After the moist heat of the day, nights can turn cold.

***By M. S. Maxwell, Ph.D., Research Specialist, Maxwell AFB, Alabama***

ON global maps, the tropics appear as those areas which are shown on either side of the earth's equator. They are usually thought of as dense rain-forests, or more popularly as jungles, although they also include vast regions of grasslands and high mountain slopes.

The tropics of Africa, southern Asia and the western hemisphere have many individual differences, but in general they are characterized by a moist, hot climate. The average temperature of the coldest month does not fall below 68°F., and there is usually more than 38 inches of rainfall in a year. After the enervating muggy heat of the daytime, the evenings often seem cold.

Practically every afternoon, especially during the summer months, a torrential rain falls, and after an hour or so, stops suddenly, leaving jungle paths deep in mud and the vegetation soaked and dripping. The vegetation may be so dense with vines, aerial roots of trees and bamboo thickets that a traveler off the established trail must cut his way through. Or the thick vegetation may all be at the jungle ceiling 50 to 100 feet above the ground, leaving the surface blanked off from sunlight and almost bare of plants. There may be an abundance of wild animals or there may be relatively few. Even where small game is plentiful the animals may travel only at night and never be seen by the day-time hunter.

This is the environment in which an airman may suddenly find himself. He may be flying in comparative comfort above the green tropical rain-forest, and a few minutes later find himself in the middle of strange noises, myriads of biting, stinging insects, and a damp heat which makes his clothes stick to his body.

Nothing is more natural at this point than fear. The airman has had the emotional shock of bailing out, or of riding a crippled aircraft to a forced landing. If he is like 60 per cent of the men who have had survival experiences he is about to spend his first night alone in the forest. He doesn't quite know where he is or how to get home and all of his childhood fears of being lost in the woods start pressing in on him. This is the critical point in any survival experience. The next few minutes may make all the difference between life and death. He must remember that at this moment he is very prone toward irrational behavior. He must remember to keep his hand off the panic button.

A tragic example of this irrational behavior comes from the Burmese jungle during World War II. A pilot, after bailing out over the rain-forest, found his parachute caught in the trees and his feet suspended about five feet above the ground. In releasing himself he first unbuckled his chest strap and one leg strap. He slipped, caught his left leg in the harness and hung head-down with his head touching an ant hill.

Immediately, biting ants swarmed over him. In desperation and panic he pulled his gun and fired five rounds into the webbing holding his foot. Unable to break the harness, he put the sixth round through his head. A short distance behind him were aerial tree roots with which he could easily have pulled himself up to release his harness. Fear, coupled with the pain from the biting ants, had led him to completely irrational behavior and the loss of his life.

What can the downed airman do to conquer this normal reaction to fear? Three important steps will help.

- Before flying over jungle areas, make up your mind that *it can happen to you.* Be mentally prepared for an emergency landing. Then if it comes, it will not be such a shock.

*ABOUT THE AUTHOR—Dr. Maxwell, now a staff member of the Arctic, Desert, Tropic Information Center, is particularly suited to write an article on jungle survival. He is a doctor of anthropology and has done field work in the Pacific, Mexico and Central and South America.*

*During World War II he served as a Navy pilot in the South Pacific, where he gained first hand knowledge of the jungle covered islands of that area.*

*Much of the material used in the article is taken from the new survival manual, AFM 64-5, which was compiled and written by the ADTIC Staff at the Air University. Staff members also collaborated in collecting other information used in the article, under the direction of Dr. Paul H. Nesbitt, Chief of the Information Center.*

- Get all of the survival training you can. Records of survival experiences show that the man trained in survival techniques is less likely to go thorugh initial panic in the actual survival emergency.
- When you are on the ground, sit still for a few minutes. Don't rush into action. Analyze your situation and plan your first moves. When you are able to put your energy to constructive use, keep busy.

The airman who lands unexpectedly in the jungle has three things that determine his chances. First, and according to survivors' accounts, the most important, is his physical condition. Physical fitness cannot be stressed too often. It may be a long walk back.

Second is the equipment he carries and the clothing he wears.

Third is the knowledge he has of how to make the best use of this equipment and how to improvise equipment which he does not have. It is for the purpose of providing this information that survival training schools have been established. This training is supplemented by such written materials as the recently issued Air Force Manual 64-5 SURVIVAL, and publications of the Arctic, Desert, Tropic Information Center.

While you are waiting for your emotions to calm down, give first-aid treatment to any wounds and cuts you may have. Scratches and breaks in the skin quickly become infected in the warm moist tropics and they should be cleaned or disinfected as promptly as possible.

Some of the principles of survival advocated by such sources may be used under any emergency situation; some are pertinent only in the tropics. One survival problem which is particularly acute in jungle rain-forests is the one of indicating position to planes flying overhead. Often the top of the jungle may be one to two hundred feet above the jungle floor, and a plane or parachute may slip through this canopy without disturbing the foliage to any extent.

In a jungle emergency signaling should be one of your first considerations. If you have a usable radio, try to make contact with it, but do not use your available power supply aimlessly. If the forest cover above you is dense and you are not making radio contact, try to find a clearing or stream bed. Do everything possible to change the natural appearance of the clearing. Burn or cut the grass, lay out your parachute and signal panel, build a large fire and cover it with green leaves to provide a smoke signal and, when possible, use your signal mirror. If you establish contact with a plane, use the emergency ground-air code and panel signals.

From this point on the steps to be taken in any survival experience may differ according to the immediate situation and the terrain in which the survivor finds himself. However, it should be kept in mind that shelter in the tropics is nearly as essential as shelter in the Arctic. A carefully built shelter will keep most, if not all of the rain from you and help to protect you from the insects. Furthermore, it is a constructive and time-consuming job that will help you to make the mental adjustment to your new situation. A fire burning in a reasonably dry shelter is one of the best possible morale builders. If you have landed with the plane and a portion of the fuselage is intact, use it as a shelter, covering the openings with a single layer of parachute cloth to keep out the insects. If you have bailed out, make a simple tent or lean-to with your chute.

Above all else, in the tropics, hang on to your chute. It is one of the most important single items for your survival. Do not try to sleep on the bare ground. If there is time in the day, make a sleeping platform with four corner posts high enough to support parachute cloth for a mosquito netting. Or use the chute to make a sleeping hammock which can be slung underneath your parachute tent. If there are fairly straight poles available, and you intend to remain at one camp site for a few days, it is worthwhile to make a paratepee shelter from six panels of your chute. It provides a dry shelter with good circulation, and if you make your sleeping platform close to the ground, a smudge fire can be kept burning inside the tepee to keep out insects. Be careful in using a fire, that you don't fuse the nylon chute.

In the arctic and desert it is wise, unless briefed to the contrary, to remain near your plane. In the tropics where dense foliage may hide you and your plane from the air, it is sometimes wiser to walk out. However, travel in a tropical rain-forest is often difficult. Five items of equipment are virtually essential:

- A compass which should be consulted frequently.
- Stout shoes.
- A machete to help cut your way, find food or build a raft.
- A first-aid kit.
- A parachute cloth hammock.

If you can, follow a trail, or go downhill until you find a stream; only cut your way through as a last resort. Walk around swamps and very dense thickets. Wherever pos-

**Left, good survival techniques can be learned best through training in field.**

●

**Below. Care and transportation of injured crewmembers should be emphasized as a part of survival training.**

**Top, crews are briefed by a survival expert prior to a training mission.**

●

**Right, proper equipment and knowing how to use it can lessen the hardships during a jungle survival experience.**

sible use light wood or bamboo rafts to go downstream. Don't try to make the maximum distance each day. Don't start to travel until there is plenty of light, and stop long enough before sunset to select a good camp site and to make a shelter and fire. Adequate rest and sleep are essential, and you will get neither if you have not protected yourself sufficiently from the night dampness and insects.

A fire is of special importance in the tropics. Surprisingly, after the moist heat of the day, it often seems bitter cold at night, especially on mountain slopes or plateaus a few hundred feet above sea level. Clothes stay damp and clammy unless they are dried out before a fire, and in wet clothing a temperature of 70° is chilling.

Green leaves thrown on a fire provide a smoke smudge to keep insects away and provide one of the best signaling devices in the dense forest. Therefore it is a good practice to carry extra matches, covered with melted paraffin and kept in a waterproof container, on all over-jungle flights. It takes extra preparation to lay a fire in the rain-forest. Select dry, dead limbs still attached to the trunk, or sticks caught in the tangle of aerial vines. Split as many of the sticks as possible, and make a bed of thin shavings before wasting a match. In carrying fire on the trail fill a dry coconut husk with live coals, or put live coals and dry punk in a segment of green bamboo.

### Purify Water

Water is often a problem in the tropics, and there are regions, especially in limestone country, where surface water is very scarce. All surface water in the tropics must be purified, either by boiling it for at least one minute, or by adding eight drops of 2½ per cent solution of iodine to a quart of water and letting it stand for 10 minutes, or by using the water purification tablets in your first aid kit according to instructions. A refreshing substitute, requiring no purification, can be gotten from the green coconut. Many of the jungle vines contain a water sap. Cut off a three to six-foot segment of vine and let it drain into a container. Never drink from a vine that has milky sap. Old, cracked segments of bamboo may contain rainwater. Shake the stems until you hear one gurgle, then cut a small notch in the base of each node.

Rainwater can be gathered in a number of ways and need not be purified. The method most commonly used by jungle survivors has been to catch the water in a hole lined with a poncho or tarpaulin.

Food is often more of a problem, but in some tropic areas there is a wide diversity of wild foods. Most moving things in the rain-forest are edible, although they may not appear appetizing at first. Grubs, insects, bats and snakes will not take the place of sirloin steak, but they have kept many survivors alive until they could reach help.

Plant food is generally more readily accessible to the survivor in the tropics than is animal food. Look for plant food in forest clearings, along the coast and margins of streams and in swamps. The natives clear garden areas in the forest, plant crops for two or three years and then abandon the garden clearing. Often food plants will persist around the edges of these clearings long after they have been reclaimed by the jungle.

Learn to identify as many potential sources of food as you can before operating over tropic areas. If you are in doubt about a plant, remember these rules of edibility:

- Never eat large quantities of a strange food without first testing it.
- Prepare a cooked sample, then take a small mouthful, chew it and hold it in your mouth for five minutes.
- If it still tastes good, go ahead and eat it. If the taste is disagreeable, don't eat it.
- A burning, nauseating, or bitter taste is a warning of danger. Except for poisonous mushrooms, a small quantity of even a poisonous plant food is not likely to prove fatal or even dangerous, whereas a large quantity may be deadly.

Health and sanitation must be attended to with more care in the tropics than we are accustomed to use in the temperate zones. Wash your clothing and body frequently. At regular intervals throughout the day, inspect your body for ticks and leeches. Remove them carefully and paint the bites with disinfectant. In removing ticks it is very important that you do not leave tick mouth parts inside the wound. One of the best ways to remove a tick is to slip a thin knife blade between the tick and the skin, pinch the tick against the knife blade with the forefinger and withdraw the tick slowly and carefully. Disinfect all cuts and blisters. Above all else, get plenty of sleep and rest. With rest, drinking water, and self-confidence a surprising number of survivors have made their way through the tropic jungle with no lasting ill-effects.

Like other more technical aspects of air operations, confidence gained through adequate information and training makes the difference between a successful survival experience and a gruelling nightmare. The following survival account, experienced by a fighter pilot early in World War II, could stand as a model of what *not* to do in the tropics. True, hindsight criticism is easy to make. Many of the errors committed here were not the result of poor judgment, but of the inadequate information available to airmen in the early days of the

**Downed crews able to get the word out are virtually assured of a quick rescue.**

South Pacific. With what we now know about tropic survival, no airman should make the same mistake today.

The pilot had taken off at dawn to provide fighter support for a bombing mission in the Solomon Islands. With little warning, the oil pressure dropped, the engine began to run rough, and finally quit. At a low altitude he bailed out over the water. A loose leg strap which he had neglected to check before takeoff dug deeply into his left thigh as the chute popped. In the water he freed himself from the chute and let it drift off as he tried to inflate his Mae West. It was faulty and would not inflate. Fortunately, his seat-type rubber raft inflated normally.

Once in the raft he removed his jungle back pack and checked the contents, spreading them on the sides of the raft to dry. His flares, matches and compass were soaked and useless. He took off his shoes and put them in the bottom of the raft. Two planes from his element approached him, flying 500 yards apart, 100 feet above the water. They passed on either side of him but he could not signal them.

### Squall Strikes

Preoccupied with the planes, he failed to notice the approach of a squall. It struck before he could make any preparations and the raft capsized. Loose gear spread around the raft was immediately lost. When he righted the raft he found that all he had left were his clothes, minus shoes, a knife, a .45 pistol attached to his web belt, a poncho, sail and mosquito head net. His pistol soon became rusty and inoperative and he threw it and 14 rounds of ammunition away, believing that they could be of no further use to him.

All that day and the next, with only his hands for paddles, he tried to reach an island which appeared to be less than three miles away. He had discarded his helmet and goggles and his face, eyes and lips were becoming badly burned.

Toward sundown of the second day he reached a small island, pulled his raft on shore and camouflaged it with palm branches. He found two coconuts, husked them, punched out the eyes and drank the fluid, then cracked the nuts and ate the meat. For protection from swarms of mosquitoes, he moved down to the beach for the night. He used his inflated raft for a bed, wrapped his feet in the sail, covered his head with his undershirt and mosquito net and kept his hands in his pockets, but the buzzing of mosquitoes and the rattling walk of land crabs kept him from sleeping very soundly.

The next day he explored his small island. Much of the coast was mangrove swamp and there were no signs of human life. He then decided to move on to the next island. He was afraid that wooden paddles might puncture his raft so again he used his hands to paddle.

He found abundant wild life on the next island. There were pigs, chickens, pigeons and fruit bats, but he made no attempt to catch any of them in traps or snares. Day after day he paddled from island to island, subsisting only on coconuts and spending each night on the beach of a different island. One night he felt a heavy animal walking over his bed. Terrified, he threw it off and dashed with his boat into the water. Looking back, he saw a large iguana lizard.

He was shaken, and pushed on immediately for the next island. Rats and mice were plentiful on most of the beaches. They ran across his poncho as he tried to sleep, and occasionally nibbled at his fingers. On the seventh day of his survival experience he used his knife to open a coconut as he was proceeding from one island to the next. The knife slipped from his hands and punctured the rubber raft. From then on he was forced to limit his raft trips, and he had to wad a sock into the puncture and hold it in place with his foot whenever he used the raft.

**In the tropics, a machete can be used to get firewood, build a shelter or improvise a trap to obtain needed food.**

By this time his bare feet were badly infected by many coral cuts, and his hands, immersed daily in salt water, were cracked and bleeding. His head ached constantly from the glare of the sun on the water. He had eaten nothing but coconuts since coming down in the water. At one point in his journey, he was isolated on an island for five days by violent storms. The island had no coconut palms, so for five days he ate nothing, hiding from the storm under a narrow ledge on the side of a hill. On this island there were many wild pigs, bush rats and fruit bats (flying foxes), but he did not know how to catch them. He did not know any of the native fruits or vegetables, and he did not dare to

experiment with the ones he found.

After 15 days of survival he arrived at a coconut plantation. Physically, he was exhausted. He had diarrhea, his hands and feet were infected, his leg and arm joints were swollen and ached.

He approached the plantation house carefully. It was deserted, but he found some limes which he ate, and in the back of the house he found a dozen eggs, all over-ripe, but he rationed himself to two a day and choked them down with fresh water.

After three days at the house he put some limes and the rest of the eggs in his pockets and set out to find the original island on which he had first landed.

At sea a violent storm tossed him back on the beach. In a state of exhaustion he tried to set out again but collapsed; delirious, raving and screaming. Here he was found by a Bogotu native, nursed, fed and eventually returned to his organization where he was brought back to health.

Let us check this survival experience error by error. The pilot had failed to track his formation and was not at all sure of his position when he went down. He had not made certain of a good fit in his parachute harness, and the resulting injury to his thigh pained him for the full 32 days of his survival ordeal. In the water he threw away his chute, one of the most valuable survival items available in the tropics. (See AF Manual 64-15, Emergency Uses of the Parachute, which is packed with the parachute log record in each chute.) His Mae West had not been inspected and tested prior to takeoff, and it failed when he needed it most. Even though it was inoperative as a life preserver, he could have saved it and made sandals from the heavy rubberized fabric. When he was finally settled in his inflated raft he spread out his gear to dry, without taking the precaution essential in dinghy and raft operation of lashing everything securely to the raft.

His matches and compass presumably were soaked and worthless and he threw them away, although there was a chance that he might have been able to dry them successfully. He had taken off his shoes and neglected to lash them to the raft—a mistake which was nearly fatal. Since his gun was rusted he assumed that his ammunition was worthless and threw it away. However, there is a chance that had he saved a few shells the powder would have been of assistance in starting a fire.

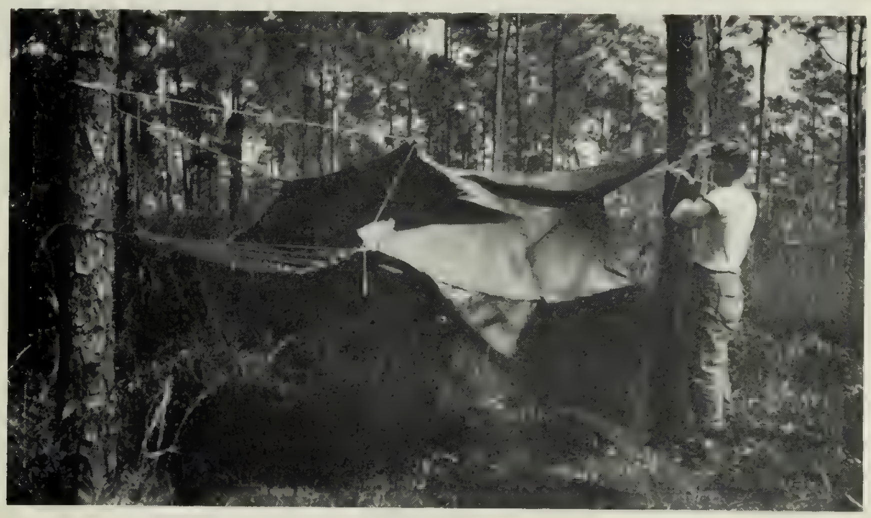
He arrived on a small island with a sunburned face and lips. There were plenty of coconuts, and the oil from these would have eased the pain from sunburn and salt water sores. It is true that the coconut oil can be rendered more easily with fire, but it is possible to get a usable amount of oil by shredding the meat and placing it in an empty shell in the heat of the sun.

In anticipation of further injury from the sun, and for protection from glare on the water he might have woven a simple head shade out of coconut palm leaves. The short time necessary to make a sun shade would have been worthwhile in view of his severe headaches.

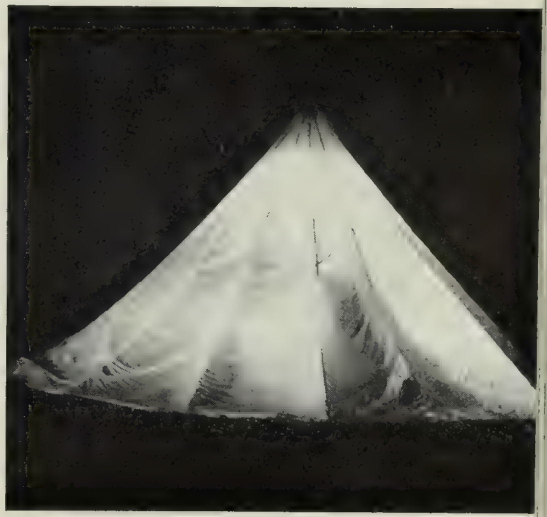
From a description of his ailments it is apparent that his diet of coconuts was not adequate for his long survival period. In this light it is tragic to note that the central Solo-

**Use a small, hot fire for cooking.**

**Tarpaulins or parachutes can be substituted for the standard jungle hammock.**



**Six panels of a chute provide a dry shelter with good air circulation.**



mons are one of the richest areas of wild foods in the South Pacific. Some of the more common vegetables are the palm cabbage, papaya, and wild plantain. Many of the shellfish are edible raw as well as cooked, and the iguana lizard which so terrified him provides a delicious meat similar to breast of chicken.

Each airman stationed in the tropics should make it his own responsibility to learn to identify as many of the native foods as possible.

Probably the greatest error in judgment displayed in this account is the pilot's decision to keep on wandering from island to island with no planned course. His wanderings took him in a large circle, nearly returning to his original starting point, and at no time was he prepared to signal passing friendly planes. The island on which he originally landed, closest to his bailout point, was the logical place for friendly forces to locate him. Had he remained here for several days he might have made a more comfortable shelter, dug signal trenches on the beach, made sandals to protect his feet from coral, and set traps and snares for the birds and animals on the island. Instead, his endless wandering, burning up his available energy, so exhausted him that he probably would not have survived had he not been found by a native on the 23rd day of his survival experience.

A little training plus some self-confidence in his ability to survive would have spared this pilot most of his ordeal. A case in point showing how training when combined with confidence can virtually eliminate hardship is that of two airmen forced down in the Burmese jungle, during the war.

The surrounding terrain was covered by dense rain-forest, but fortunately the pilot was able to pick out a small clearing when his engine started to miss. He glided into this field and plowed into a growth of elephant grass which nearly covered his plane.

After evacuating the damaged plane the two men made an inventory of their equipment. They had a flare pistol with eight flares, two chutes with jungle kits and two .45 pistols with a total of 23 rounds of ammunition. Each jungle kit contained a machete, a pocket compass, a first-aid kit, a bottle of insect repellent, and a Type B-4 frying pan insert containing atabrine tablets, boric acid, fish line and hooks, band-aids, sulphadiazine and a bottle of halazone tablets. One man wore only his khaki uniform, while the other had a leather jacket in addition to his khakis. Their rations consisted of one-half canteen of water and three bars of D ration chocolate.

After eating a square of chocolate apiece, they set about making their landing site more readily observable from the air. They opened one of the chutes and spread it out in the clearing. Then, with their machetes they cleared the grass from a large area around the plane to make it more easily seen. They removed the engine cowling panels, cleaned them with gasoline to make them as bright as possible, and spread them on the wings. By that time it was getting dark, so they retrieved their signal chute. Each man wrapped up in one half of it, and after liberally dousing themselves with repellent, lay down in the plane to sleep.

### Search for Water

In the morning they set out to increase their scanty water supply. By standing on the wings of the plane they could see what appeared to be deserted native huts in the distance. They hacked their way through the grass, making a clearly marked trail from the plane and found a native house in a fairly good state of preservation with a small, muddy well nearby. Having made certain that water was available, they returned to the aircraft to be ready to signal in case planes should come over. Numerous transports droned overhead, but failed to spot the crashed plane or the small smoke flares. The two men fervently wished for a signal mirror. (It has been demonstrated time and again that the sighting mirror is one of the best possible ground-to-air visual signaling devices.

Toward dusk they returned to the deserted native hut for the night. They took all of their equipment with them, intending to strike out for a known road the next morning. The aircraft emergency had occurred so rapidly and at so low an altitude that they were not certain of their position, but they felt sure that the road was southwest of them approximately 10 miles away. Before leaving the plane they checked their pocket compasses and found that they compared favorably with the aircraft compass.

In the native hut they built a fire, boiled the muddy water from the adjacent well, and strained it through several layers of parachute cloth. Then they rigged a parachute shelter inside the hut to keep out insects, put down a double layer of cloth for a mattress, a double layer for blankets, used the chute cushions for pillows, soaked parachute cloth in insect repellent, tied it about their heads and necks and settled down for the night.

The next morning they were certain they would hit the road during the day. But to be on the safe side they packed up their indispensable parachute cloth and other equipment and lashed it to an improvised pack made from a parachute harness. Previously, in exploring around, they had discovered a game trail bearing in a general southwesterly direction, and they set out on this. It was soon apparent that a number of buffalo, tiger and elephant were using the same trail, but the men had no intention of tackling such game with .45's until hunger drove them to it. The trail meandered through the forest, but at frequent intervals they checked their progress with the two compasses.

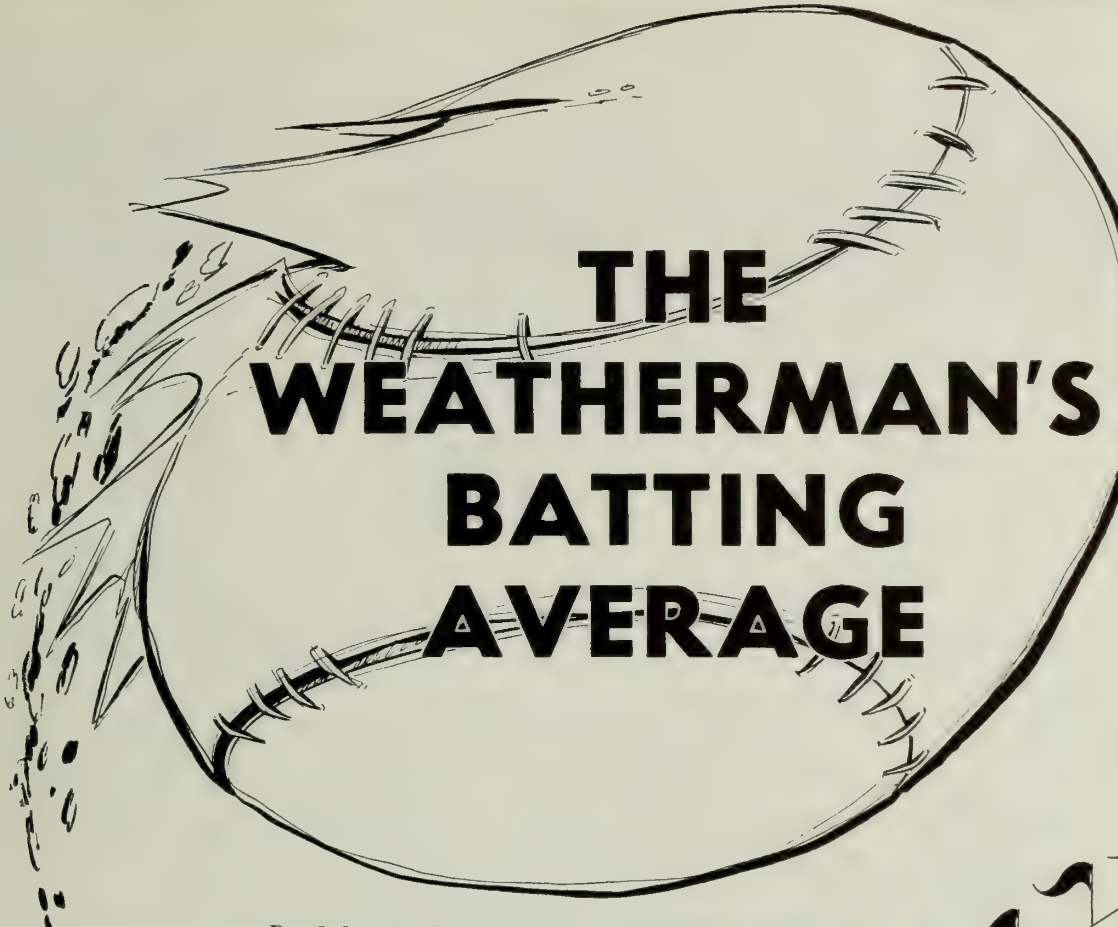
At one point they came to a deserted native village and an orange tree which they stripped of ripe fruit. They found small game, such as barking deer, wild turkeys and a partridge-like bird to be plentiful, especially around the forest clearings. Leeches were a nuisance, even though they had wrapped strips of parachute cloth around their legs, and they made frequent de-leeching stops. During one of these stops they heard the hum of a truck on the highway, and 20 minutes later had hitched a ride back to their outfit.

The survival experience of these two men was short, and not particularly eventful, but the value of its retelling lies in the words of one of the survivors:

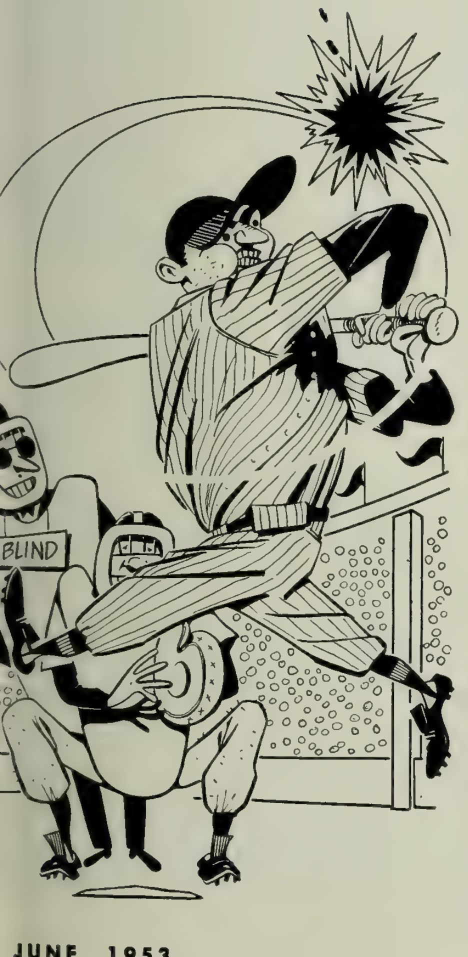
"Although our experience in the jungle was in no way a harrowing one, we did pick up a few pointers, and *gained considerable confidence* in our ability.

"With gun, machete, compass, canteen, halazone tablets, matches, enough clothing, sound training and plenty of *good common sense*, the jungle need not be a nightmare to anyone." ●

# THE WEATHERMAN'S BATTING AVERAGE



By John D. Rugg, Hqs. Air Weather Service



It is common practice for most of us to think of the weatherman as "that idiot" who promised a fine day for the picnic that was completely rained out.

Pilots may remember a comparable example of inaccurate weather forecasting for a flight, such as the time he was briefed for good weather all the way and then ran into a blizzard over Pittsburgh and had to turn back.

Remember? Of course, you remember those times when the weatherman turned out to be a bad prophet. But jog your memory a little harder and bring to mind the many times his forecasts came through right on schedule. Then draw a quick comparison between the numbers of good and bad forecasts. What's his batting average?

For the past several years, the USAF Air Weather Service unit at Tinker Air Force Base in Oklahoma has been conducting a survey into the accuracy of weather forecasts. Believing that forecast is best which best serves the need of the pilot who receives it, the AWS unit at Tinker carried on its survey by a pilot comment card system. Each pilot who received a weather briefing was given a post card on which he was asked to indicate his opinion of various aspects of the weather service furnished him.

The latest compilation of results from the Tinker AFB survey, covering four weeks in winter, when forecasts are most likely to go wrong, showed the following:

- Promptness and Efficiency of Weather Briefing (3,117 pilots reporting): 98.95 per cent reported "good", 0.06 per cent reported "fair", 0.99 per cent reported "poor".
- Weather Forecast (3,011 pilots reporting): 97.1 per cent reported "satisfactory", 2.9 per cent reported "unsatisfactory".
- Wind Forecast (2,997 pilots reporting): 95.1 per cent reported "satisfactory".
- Landing Weather from Tower (3,048 pilots reporting): 99.2 per cent rated it "accurate".

This is an over-all batting average of .976 for all factors of the weather forecast. Ty Cobb at his best for Detroit in 1911 reached a batting average of only .420, and the great Rogers Hornsby batted the highest recorded average in 1924 at .424. ●

# Base Flying Safety and *you*

***You may never be assigned as a flying safety officer, but if you fly you should know how the program works . . . for your own good!***

IF you see a senior pilot with a harried look on his face, skimming along the ramp in a jeep to the scene of a taxi accident, the chances are eight to five that he's the base flying safety officer. He's one of the busiest men on the base, for he's a Man with a Mission . . . that of keeping the USAF aircraft accident rate at its all-time low.

However, as base flying safety officer, he is just one cog, albeit an important one, in the machinery of the USAF flying safety program. This story endeavors to show you how a base flying safety program is planned, organized, and carried out, for YOUR ultimate safety.

Like the sign in the saloon that read, "Don't Shoot the Piano Player, He's Doing the Best He Can," we entreat you, don't be too hard on your FSO because chances are that he, too, is doing the best he can with a difficult and oftimes complicated assignment.

### Flight Safety Council

The foundation of the base flying safety program is the flight safety council. This council acts as an advisory group to the Commander in all things pertaining to base flight safety. The flight safety council usually consists of the flying safety officer, the flight surgeon, the chaplain, the operations officer and the engineering or maintenance officer.

This council is a group of men with exceptionally broad experience with not only the flying machine, but also with the human beings who fly them, from both the spiritual and physical viewpoint. Of particular value to the base commander are the knowledge and thinking of the surgeon and the chaplain, especially in the consideration of the human factors in aircraft accidents.

The flight safety council reviews, evaluates and recommends base flight safety policies and actions, both in the planning stage, and in the accident investigation stage. The formation of a base flight safety council is strongly recommended by the Directorate of Flight Safety Research. Base commanders who use the council to its utmost capabilities are usually rewarded with low accident rates.

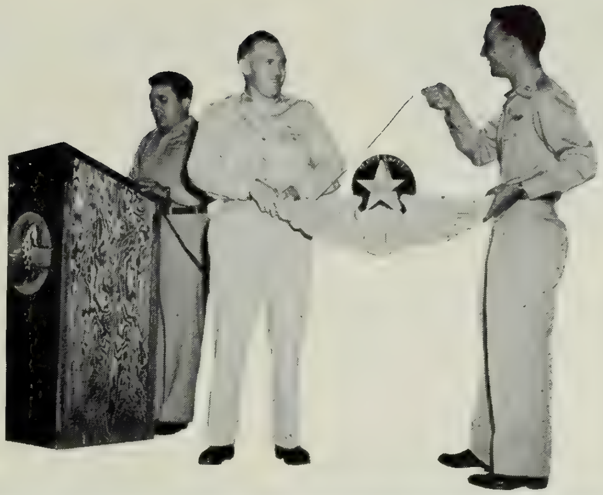
All of us who tool airplanes along the fleecy sky lanes have attended, or slept through, flying safety meetings. If you are the sleeper type, chances are you have had or are going to have an accident, although it is evident that if your flying safety meeting invokes a state of dormancy, the fault may be with the flying safety officer's planning. Concerted and piercing screams directed to this gentleman will usually bring about a new flavor to flying safety meetings.

The smart flying safety officer has a trace of showmanship about him, which is reflected in his meetings. At one base in Florida, the meeting often takes the form of a playlet acted out by base personnel, in which various points of flying safety are stressed.

This method means a great deal of work on the part of the FSO and his staff, but it pays off in the long run because it impresses indelibly on the audience the basic facts of safety in flight. It never hurts to have a laugh or two in every meeting, particularly if it drives home a point.

Other flying safety officers bring in experts on various phases of flight operation at each meeting. Pilots and crewmen like to meet the men and women who work with them on the ground. It is surprising to many pilots that weather forecasters, tower operators, and GCA crews are human beings like themselves. By bringing together the flying and non-flying personnel at these meetings a better understanding is created among all concerned. The pilot begins to understand the problems that constantly come up in the control tower cab and in the GCA shack.

Another source of program material is the Civil Aeronautics personnel in the region. These are the men who run INSAC (communications), the Approach Control and the nearby civilian airport operations. Here



**Comprehensive, up-to-date navigational aids, a few laughs at the Flying Safety Meeting, and some interesting discussions can pay off some big dividends.**

again, knowing the problems of the CAA in relation to military traffic is a safety factor that cannot be overlooked.

Your flying safety officer should always expose you to any changes in Air Force Regulations and T.O.'s that affect you. Good old AFR 60-16 cannot be too deeply stressed, and the Dash-Ones for the aircraft you fly should be reviewed constantly. If there are any changes in airfield layout, airfield lighting, or if new obstructions have appeared in the area, these should be stressed at meetings.

### Meetings Mandatory

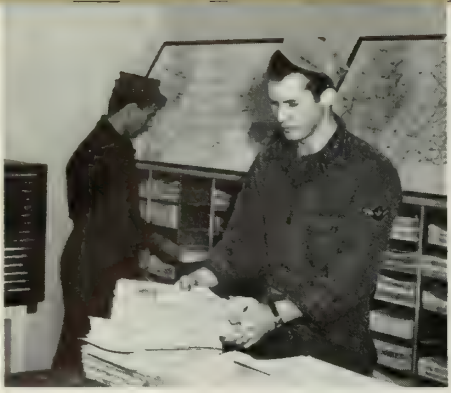
At most bases the flying safety meetings are mandatory for your own good. The ingenious excuses people can think up to avoid attending a base flying safety meeting are amazing. At Elmendorf Air Force Base in the Alaskan Air Command, flying safety meetings are held twice a month. This allows personnel to attend either one or the other, but attendance of at least one meeting a month is mandatory. Attendance is carefully recorded and sent to the base commander. Failure to attend brings an RBI.

Strategic Air Command and other commands have found that the use of Incident and Near Accident Reports tends to keep the accident rate down. This report can be very simple in form, and should be put on a voluntary basis as far as the signature of the man making the report is concerned. Near accident reports bring to light many situations at your base that would not normally be noticed until an accident occurs. These near accident reports cover inaccurate forecasting, crowded ramp conditions, careless tower control procedures, and faulty installations as well as poorly planned traffic patterns and other factors which can, and do, give you a close call now and then.

The idea is not to be a tattletale, but to eliminate the hazard for the man behind you . . . or maybe even you, the next time you're up in the blue!

### Bottle and Throttle

Down at Reese Air Force Base there is a sign hanging in the operations office. It reads "Twenty-Four Hours Between Bottle and Throttle." It's a damn good rule to follow. You may think you're the he-man, but the aviation medicine men know differently. Your flight surgeon can tell you just how those three Martinis you had at the club the night before that long cross-country affect you, and it's not worth it . . . even if you did win those drinks at poker dice. Flying safety officers who are really on the ball have pushed through fair and workable rules for the use of alcohol before any flight. They have educated flying personnel to the reasons why it's better to be a teetotaller before any flight, not because of any moral reason, but because men and machines cost money. That no-drink-



An important phase of good flight planning is seeing that you have the maps and charts you'll need.

10,000 hours of safe flying merits congratulations and a special citation from the base commander.

A clean, well-planned operations office plus good dispatchers can help your program, and its a fact visual aids sell the "Message."

ing rule is for your own good, and not because anyone wants to be a spoil-sport.

Another phase of flying safety that ties in very closely with the "Bottle and Throttle" rule is in the domain of the chaplain. These Men of God who are usually very human and understanding of the troubles of the world, can be valuable assistants to the flying safety officer.

A man can't do a good job of flying if he has troubles on his mind. And a good way to get these troubles off your mind is to talk them over with the Sky Pilot of your outfit. It is quite possible that he can suggest a solution. If he can't, you at least have them out of your system, which tends to relieve that nervous tension. To put it bluntly, woman trouble is the cause of more than a few aircraft accidents and most of these situations have a solution.

Learn to rely on your chaplain. That's why he's a member of the flight safety council. You'd be surprised at how much he knows about what's going on around the base, and off the base, too, for that matter!

### Safety Education

Each month the Directorate of Flight Safety Research mails out to every Air Force Base a series of safety education publications designed to help you increase your flying safety factor. Basically these are *Flying Safety Mazagine*, written for the aircrew; *Aircraft Accident & Maintenance Review*, designed for the engineering people; *Rex Riley* posters, just to remind you; *Flying Safety News Bulletin*, for the edification of flying safety officers; and *Letters to Commanders* which point up salient developments in the field of flight safety of particular interest to your base commander.

Big business has found that employee relations can be strengthened by various awards for achievement. Along this line, many base commanders have also found that flight safety consciousness can be strengthened by an award system, either to crewmembers or to individual pilots. At one Air Force Base, the outstanding pilot for the month is awarded a huge set of wings, on which is inscribed: "Flight Safety Monthly Award."

Other bases award citations to air crews who have flown together for a specified number of hours without an accident, and to the crew that passes the 10,000 hour mark on the base without an accident.

Awards of this kind should be made in behalf of the crew's organization, and every man on the base must be made to feel that he is a member of the team and partly responsible for the record. Air Force-wide, flying safety plaques are awarded twice a year to bases having the lowest accident rates and plans are in progress for similar awards to be made by the aircraft industries to USAF individuals, crews, or commands having made outstanding contributions to flight safety.

### Accident Investigation

Not the least of the flying safety officer's duties lie in the field of accident investigation. He must be thoroughly familiar with AFR 62-14, and be able to carry out an aircraft accident investigation efficiently from the scene of the crash to the final Form 14 report.

In order to train flying safety officers in the proper procedures of aircraft accident investigation, the USAF, through the Directorate of Flight Safety Research, has set up a school for flying safety officers at the University of Southern California that will turn out trained, professional flying safety officers.

Getting right down to it, the flying safety officer has to be quite a man. He must be a rated pilot and should be current in all types of aircraft flown at his base. Most FSO's are instructor pilots and instrument instructor pilots, and those that are really on the ball, usually set up spot checks for base pilots and even IP's to be sure that aircraft qualification standards are high.

In addition to his flying duties, he must be an organizer and an educator. He must be able to analyze an aircraft accident, and to write a complete and coherent report on the accident. He must know operations, facilities and installations as well as men and machines. He usually works with a minimum of assisting personnel, and oft-times must type his own reports.

He is on call twenty-four hours a day, and must eat, sleep and live flying safety. His rewards are not material, for he is usually a company grade officer, but his satisfaction is great when he knows that his flying safety program has saved an airplane or, more important, the crew of that airplane. Wanna volunteer? ●

# AFR 60-16 —The Pilot's Good Book

### It's the one regulation that you have to live with and the one regulation that's most often violated!

AIR FORCE REGULATION 60-16, officially known to the trade as "*Flying . . . Air Traffic, Clearance and General Flight Regulations,*" might well be hung around the neck of many pilots, like the albatross on the Ancient Mariner.

It's the one regulation that every flying man has to live with, and it's the one regulation that is violated most . . . intentionally or unintentionally. It's the one regulation that is stressed in the written instrument examination, yet with the exception of certain paragraphs, the average pilot knows less about AFR 60-16 than he does about the telephone directory.

Most of you know by this time that there is a new version of AFR 60-16 extant, with certain changes. These changes make many study guides, to say nothing of the current written instrument examination, obsolete. That's why we want to run over a few of the highlights of AFR 60-16, lest we forget.

For instance, we find that the regulation says that all aircraft operating along civil airways will be flown on the center line of the airway, unless specifically designated by Air Traffic Control. This does not mean that when you file and fly airways you can cruise down the lane five or ten miles to the right or left. It means the center. How many do it?

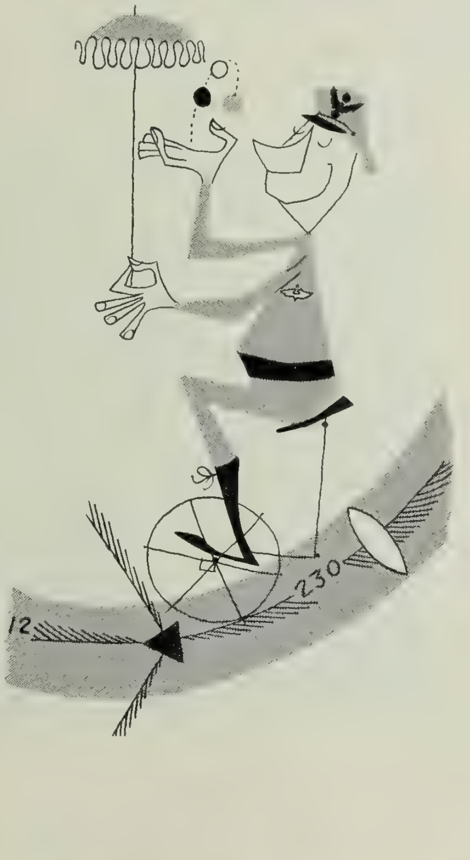
And here's the word on navigation lights. You don't wait until it's black as the inside of a P-1 helmet before you look around and switch on the wing lights. You do it 30 minutes before sundown, and keep them on until 30 minutes after sunrise . . . or at any time when the flight visibility is less than one mile.

Another thing, you don't taxi within 100 feet of any aircraft parking area or within the parking area itself, without at least one man on your wingtip, or ahead of your airplane far enough for you to see him at all times. The Form 14 files are full of tales of aircraft damaged because of the absence of a wingwalker or a "follow-me", and an impatient pilot.

This brings up a moot point. You are to keep your earphones on, and your radio tuned to the tower frequency, not only while taxiing, but until you have parked the beast and the switches have been cut.

One of the most important parts of the regulation, and one that is violated daily, sometimes to the detriment of the crew, airplane, and passengers, is Paragraph 19, "Use of Oxygen." It says that crewmembers will use oxygen when the cabin pressure altitude is 10,000 feet or higher. It *encourages* aircrews to use oxygen on prolonged flights when cabin pressure altitude is 8000 feet or above, and makes use of oxygen mandatory above 14,000 feet.

This brings us to the part about parachutes. It is the responsibility of the *pilot* to see that not only his crew, but his passengers have their parachutes correctly fitted, and that they know how to use them. Don't leave this checkup to the crew chief.



There are some aircraft commanders who insist, even in a Gooney, that the crew, as well as the passengers, wear their parachutes during the flight, comfort to the contrary. It is also the *pilot's* responsibility to see that passengers use safety belts, and that each passenger is adequately briefed on bailout and survival procedures. It's awfully easy to tell the Sergeant, "G'wan back and see that they're all fastened in, Sarge!"

## VFR Rules

In the section on visual flight rules, there has been a change. Now over-the-top flight above an overcast is excepted from VFR. This means that when you file OT, over an overcast, you must file IFR. There has been a slight change in fuel reserve, also, on IFR. Now the fuel reserve for IFR flights will not be less than 20 minutes, nor more than two hours (Par. 39).

Landing minimums have also been changed. Now no pilot, white or green card holder, will make a landing when the weather is below published minimums listed in the *Pilot's Handbook* (PHACUS, East-West.), for range or ILAS letdowns. Where there is a GCA, and a designated holding point, no pilot will make a landing when the field is below published GCA minimums listed in the Radio Facilities Chart.

The purpose of this article is not to analyze AFR 60-16, or to brief it paragraph by paragraph. It points out only those paragraphs which seem to be most constantly violated, according to accident reports. How often AFR 60-16 is violated without noticeable results, no one will ever know.

Commanders cannot stress too highly the worth of this regulation, and flying safety officers cannot repeat too often the rules set forth in this, the Pilot's "Good Book." ●

# *The FIRST TWENTY*

## USC graduates the initial class from USAF's Flight S

ON the 24th of April, 1953, the University of Southern California graduated the first twenty flying safety officers from its newly instituted course in Flight Safety Engineering.

Certificates of completion were presented to the class, followed by a luncheon. Brig. Gen. Richard J. O'Keefe, Director of Flight Safety Research, addressed the class in a short statement after introduction by Dr. Carl Hancey, Dean of the University College, USC.

The General, in greeting the class as pioneers in a program that is believed to be the first of its kind at university level in this country or abroad, said:

"I would like to take this opportunity to commend the University of Southern California for its pioneer spirit in opening up a new field of aviation education. As in all pioneering efforts, first attempts are subject to some criticism, but I am sure that your constructive criticism will contribute a great deal to the effort of the University professors in their demonstrated enthusiasm for safety of flight.

"The development of this course was the culmination of a long-time dream to give aircraft accident prevention its proper place in the Air Force educational system. Our allies—the Air Forces of the NATO countries—have expressed their desires for a place in this program. The CAA and other civilian aviation government agencies are inquiring if they can participate also.

"Our contacts with the aircraft industry show a definite interest on the part of airplane manufacturers. We have hopes that this effort at the University of Southern California will be expanded to a point where it will receive the recognition that it deserves.

"As you know, all of our aircraft manufacturing engineer organizations are now staffed with designers who have a great interest in designing out of our airplanes, those features that have caused accidents. We who are living very close to accidents, have no doubt that our designers can design an airplane of such performance that it is beyond the capability of the human to fly it.

"The pilotless airplane or guided missile has not yet replaced human operation of the airplane as a weapon. Until the long-range objective of pilotless aircraft is attained, we must accept the limited airplane performance that is based on the capability of the man. The human engineering aspects are becoming more important as our designers provide us with higher performance aircraft.

"I would like to point out that my Directorate's investigative capabilities in the field are limited to approximately eight per cent of all Air Force accidents—where we obtain first-hand information on accident causes. It is impossible for us to investigate directly—all accidents experienced. Therefore, we are greatly dependent upon the base investigation board and the approving commander to give us the majority of our source information and their action to eliminate accidents.

"You will shortly return to your home stations and I am sure you will be warmly welcomed by your commanders. All of our commanders are concerned with the impact that accident losses have on their capability to perform the air mission.

"You should make every effort to convince your commander that you must be responsible to him—and him only—in the command organization.

"To accomplish your mission, you must be critical of all his staff agencies through operations—personnel — maintenance — supply — and even staff agencies responsible for living conditions. In the military structure, to include its housekeeping there is no dividing line in accident

**Below, USAF students of the first class in Safety Engineering at USC take a break and a breather between periods. Class number two began May 11, with a total of nineteen men. Class number three is expected to begin around June 29, 1953. From the field standpoint the impact of the school is already being felt. Indications are that ARDC is reorganizing their flying safety program at command level, and MATS is placing trained flying safety men directly under the commanding officers.**

## gineering Course.

causes that directly or indirectly contribute to disasters. Inadequate living conditions and recreational facilities can add to the tensions inherent in the flying activity and will in themselves be a factor in pilot error accidents.

"Primary cause factors are strikingly similar from year to year with the chief offenders—pilot error—materiel failure—and maintenance error contributing to nearly 85 per cent of all accidents. I would like to emphasize that the predominant percentage charged to pilot error is not the true picture.

"We know that many accident investigation boards have attributed the accident to pilot error when in reality, there are other hidden causes: such as — poor pilot orientation — poor supervision—poor weather forecasting — and undetermined design and materiel malfunction factors—that are either unknown or passed over lightly by board members and should have been identified as the prime accident cause.

"You will be remiss in your duty if you do not make every effort to ferret out these conditions and fix the responsibility for the accident in its proper category. I reiterate, that to accomplish your mission, you must report directly to the commander—and, of course, you must have his complete support.

"We constantly look for the unseen, the unknown and the undetermined factors that cause accidents. It is our experience that the simplest and most ridiculous unsafe acts and conditions are often the cause. Very few of them are acceptable because, for the great part, they are avoidable and can be eliminated by exercise of good sense and sound judgement.

"The base accident investigation board is our right arm in the field. Your base boards can influence the design of future aircraft and defective materiel by disclosing unsafe conditions in the base board proceedings and by submission of unsatisfactory reports. The prompt and accurate reporting of deficiency design features and unsatisfactory equipment plays a large role in insuring safe flight. You must carefully evaluate your operations—pilot and aircrew training techniques—maintenance and inspection procedures—quality of supervision in all echelons—and the indoctrination of all operational personnel in safety concepts, with the objective of correcting the human factor.

"We find on our visits to bases that a great many of our educational publications and special studies are not displayed or used. They find their way into dead files or, are destroyed when the desk drawer becomes overloaded. Dissemination and proper use of these materials and the subjects contained in special studies will, in the long run, pay you a large dividend in the elimination of time you must spend on accident investigations and the tremendous administrative effort that accompanies each accident. Prevention is still the best cure.

"You have covered a great deal of ground in these past six weeks. We realize, and I am certain that you realize, that the course could be much longer. It is imperative that we train, even in a limited way, a large number of specialists in the accident prevention program because there has been great dearth of that talent in all command levels.

"In the short time that you have attended this course, no attempt was made to make you an expert in any specialized field. It was intended that you be given an appreciation of particular subjects related to a flight safety program. Your indoctrination in the various subjects will help you to identify accident causes and has at least exposed you to possible techniques that should be employed to solve the acident problem.

"I have been indentified with the accident prevention program for over two years and learn something new each day. You will also learn with experience. The assistance that you give your commander in accomplishing his air mission will be directly proportional to your industry, initiative, and imagination.

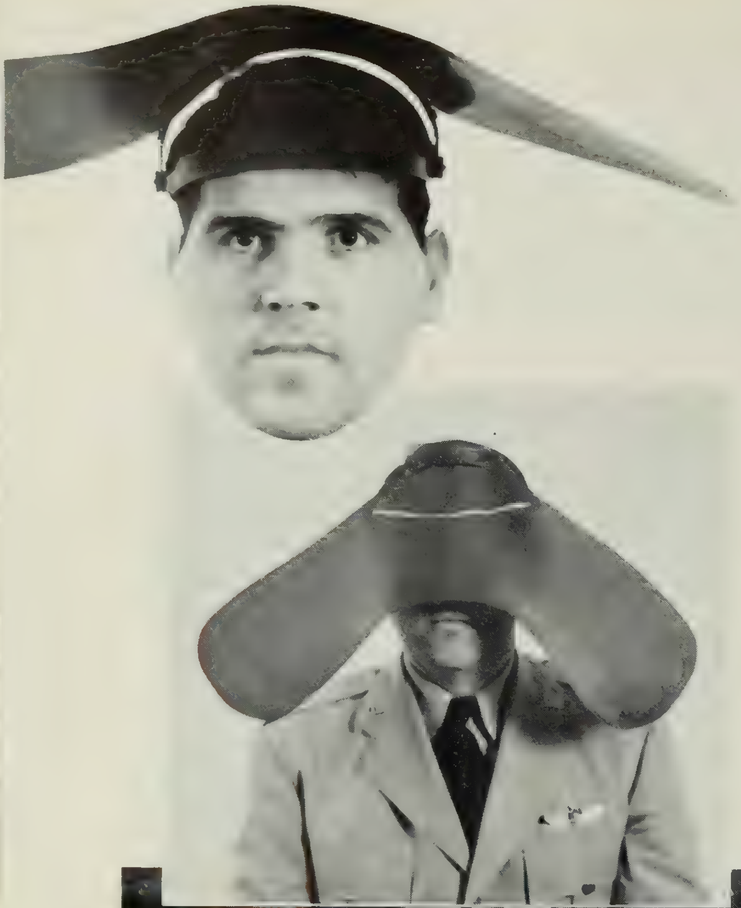
### One Precaution

"I would like to leave one precautionary thought with you upon return to your home stations. In all of your efforts toward accident prevention, do not permit your thinking to evolve about the words, 'Flight Safety.' That statement might appear contradictory, but I would like to point out that as a military organization, the safest Air Force is not necessarily the best Air Force. To make a ridiculous statement — we could stop all accidents by not flying —but if we did, our country would not have an Air Force that must be ready to defend it.

"The military flying activity is in itself hazardous—due to the air mission. Rather than permit our thoughts and decisions to stem from flight safety, I would prefer to express it as 'Accomplishment of the air mission with minimum loss of personnel and equipment.' We must first accomplish our air mission and I believe that we can accomplish the United States Air Force mission with minimum losses. That is my job—and it is yours.

"In your accident prevention activities, I would suggest that you ask yourselves these two questions: Does my effort detract from the accomplishment of the Air Mission? Does my effort inhibit the personnel who fly the combat mission?

"If you are satisfied that the answers to these two questions are 'No,' then your effort is healthy and you have contributed to the combat capability of your Air Force." ●



# HOODED for PRACTICE

*Everyone is agreed that all pilots need to practice instrument flying. The questions are: "How to go about it; what's the best method?*

●

**Above and to the left this pilot shows his choice of a hood that was developed from a welder's helmet. Below, Lt. Spencer and Capt. Swisher compare their "kite" hood with panels of the two-color system.**

BUILD a better mouse trap, they say, and the world will beat a path to your door. But don't be taken in by this mossy bromide if you're kicking around an idea for a revolutionary hood system for simulated instrument flying. Chances are your system has already seen its day and, if you would know the truth, one pilot's hood method often turns out to be another man's frustration.

Everyone is agreed that all pilots need to practice instrument flying. The only question is: "How should the pilot go about it and what methods are the best to use?"

The direct approach is to fly in instrument weather. But there are several reasons why this is not always the best approach. For one thing, instrument weather does not come as often or last as long as it may sometimes seem. For another, just stooging around in instrument weather may be dangerous . . . especially near airfields.

Simulated instrument flying offers an opportunity to practice instrument flying without the danger and distractions of actual instrument weather. The knowledge and skill gained in simulated instrument flight can and should be combined later with experience in all weather conditions.

The chief function of simulated instrument flying equipment is to prevent distraction from the primary job of instrument practice. It should be second nature for pilots to interpret the gages and react promptly with correct control action. If the instrument hood equipment helps the pilot to achieve and maintain proficiency, it serves its function well.

Many systems and gadgets have and are being used to put the pilot on the gages. And considerable research has gone on to determine the merit of each system; research that evaluated the various systems both from the point of view of pilots' experiences and needs, and from more technical points of view in the laboratory.

Although a great many variations are found in the USAF systems of simulated instrument flying, the majority of the methods used can be reduced to about four basic systems.

Loosely, these are what might popularly be termed as the two-stage system, and the hood, helmet, and louvre systems.

Here, the "kite" hood inventors have installed their instrument practice system in a B-29 and are checking the visibility features.

The two-stage technique refers to all of those methods which employ two different filters to bring about selective visibility. The hood system includes any method by which the students' vision outside the cockpit is blocked by screening material. The helmet, or "beak" type bonnet technique is worn by the pilot, whose vision is then limited to the instrument panel when the head shield is correctly adjusted.

The louvre, or slat-type method creates selective visibility by means of successive slats or cards attached to the windshield at angles to form a screen for the student, but presents only edges to the check-pilot.

According to some pilots the helmet-type system permits good instrument flying practice without the use of goggles and is comfortable, adaptable and convenient besides being easy to carry around.

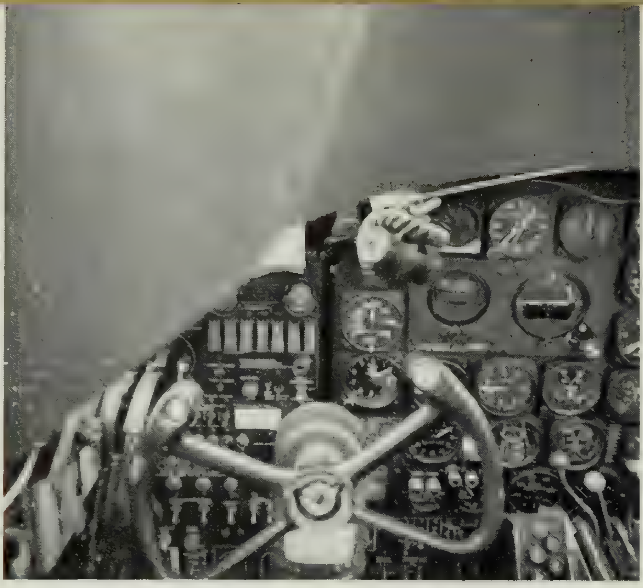
An informal survey shows different systems and hood styles for various types of USAF aircraft. In the jet fighter type, for instance, when it was found that the instrument flying hood for F-86A aircraft was unsatisfactory for use in his fighter outfit, Lt. Col. Frank J. Keller, executive officer of the 81st Fighter-Interceptor Group, decided there was ample room for improvement. After weeks of trial and error, he finally produced a design for a new type hood which left the group pilots and maintenance personnel pleased as punch with the improvements.

Col. Keller then submitted a U.R.. incorporating the design and construction of the new hood, and recommending that a hood of similar design be adopted for use in the F-86.

One of the first problems he faced, according to Col. Keller, was the time-consuming and difficult method of installation of the issued-type hood. This frequently required the crew chief to spend hours on his aircraft, rigging the hood for perhaps just one or two flights, and then dismantling and taking it out of the plane when the hood was no longer required. Also, the position of the hood when not in use restricted the pilot's visibility.

With Keller's modified hood, the pilot himself carries it to the aircraft and within a short time installs the unit and is ready for his mission.

Listed among the disadvantages of the original hood was the bulkiness and the difficulty in obtaining satisfactory hood operation. The changed version, made of mercerized cotton, incorporated three elastic strips sewn into the material to reduce size and bulk when not in use. Also added was a positive engaging-disengaging hook which enabled the pilot, with one hand, to open or close the hood



B-26 pilot's view from under a shutter-type hood.

This pilot prefers a variation of the helmet-hood.

with a minimum of time and effort.

Top selling point for Keller's hood with maintenance personnel was the fact that no modification of the aircraft was required. To test the effectiveness of his new design and to offer suggestions and criticism, numerous group pilots made many training flights under the new hood. Consensus was that the design was an improvement and as a result all of the tactical squadrons at both bases were equipped with the new rig.

In the multi-engine class, there is still another version of an instrument flying hood that has been recently developed by two Tactical Air Command flying safety officers.

This device, designed by Lt. Col. Legrand J. Mercure and Captain Albert H. Francis, is a shutter-type hood that prevents outside visibility for the pilot, while presenting no visibility restrictions for the instructor in the right seat.

Working on the principle that the pilot will see the flat side of a plywood panel while the instructor will see only the one-eighth inch edge, the new hood offers a simple, safe way of simulated instrument training, the designers say. The shutter-type hood may be used only in aircraft with side-by-side seat arrangements.

Depending on the type of airplane, the shutter-type hood normally consists of three plywood panels shaped and fastened to blot out the pilot's vision through the windshield and side windows. The panels, painted a dull black, are simple to install or remove, and eliminate the use of goggles, plexiglass headshields or other uncomfortable equipment for the pilot.

With any type of hood system, pilot comfort coupled with unlimited visibility for the instructor is an important safety factor. When the shutter-type hood panels are in place the pilot has full view of the instruments and controls in the cockpit, and the instructor can observe the pilot's technique and still maintain an unobstructed view ahead of the airplane.

In working on their particular version of the shutter-type hood, Col. Mercure and Capt. Francis kept in mind that a simple enough device was needed so that it could be made by units in the field from available materials. To make the job easy, the two TAC officers made full-scale models and patterns for the C-47, C-119, and B-26 type airplanes. The hood models were then made available on a loan basis to units.

### Building Unit

Building a hood unit requires less than ten square feet of one-eighth inch plywood, a small quantity of sheet aluminum for brackets and about five catch fasteners. No modifications on the airplane are needed and once the panels are shaped and painted, it takes less than one minute to put them in place.

From Randolph Field comes still another variation in hood styles—this one of "box kite" design which represents the latest training aid for instrument flying devices. The box style hood, say these two designers, not only speeds instrument instruction but also makes B-29 hood flying inestimably safer.

The brain child of two Randolph pilots, Capt. Lyle W. Swisher and Lt. Loren J. Spencer of the 3513th Transition Squadron, the "kites" were developed in four months from the first cardboard-and-paper model and have now been placed in use on the B-29s at Randolph.

First work on the kite-canopy flight hood was begun by Capt. Swisher, instrument instructor, because of dissatisfaction with various aspects of the existing B-29 hood types. The standard B-29 hood equipment, it was pointed out, was time-consuming to install along with other disadvantages. It restricted the instructor's vision to the left of the aircraft, and it could not be removed quickly in the event of an emergency or for making a visual landing after GCA approach.

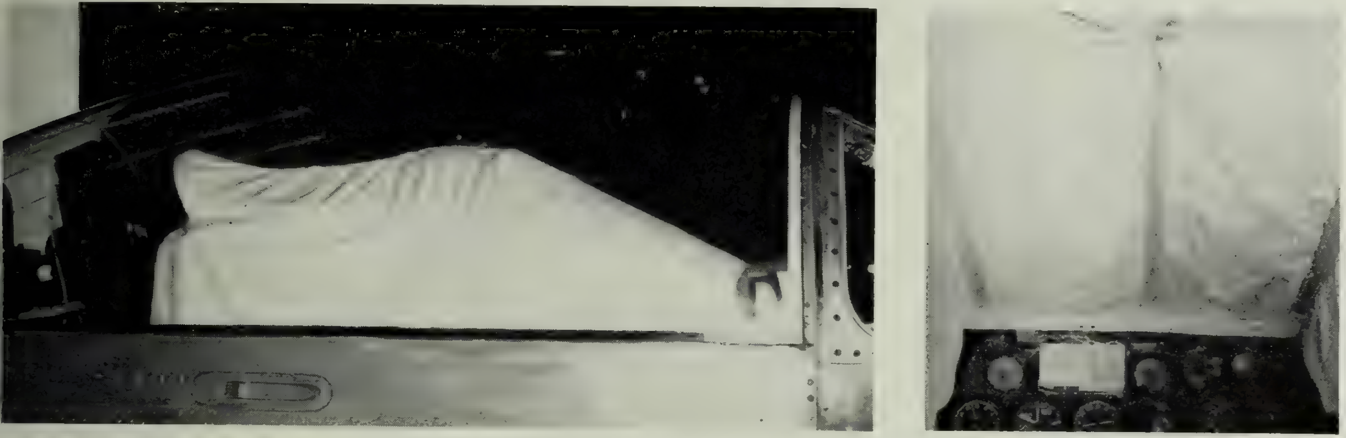
The new "kite" creation, a two-by-five foot tubular steel frame covered with linen is light and strong. In position, one end rests on the instrument panel and the other is tied above the pilot's head. Hanging curtains serve as blinders to right and left.

However, the "kite" hood does not improve the instructor's view to the left. In this direction scanners in the plane's nose and top turret keep watch. When the curtain is in place, a tug on pull-lines releases spring clips and instantly rolls the hood up like an awning to permit the student to land with full visibility. This feature was a refinement added to the original model by Lt. Spencer.

The inexpensive linen cloth covering of the hood canopy is opaque enough to block completely a student's outside view, while admitting sufficient glare-free daylight, the inventors declare.

As might be expected, the foregoing systems as well as all of the methods and variations currently in

**Utilizing a canopy style hood developed by Lt. Col. Frank J. Keller for the F-86A, the pilot in the above series of photos shows the ease of "going under" the new hood. Last photo shows the neat fit around the top of the instrument panel.**



use today will have some advantages and some limitations. But there is one simulated instrument technique that has seen the widest use and appears to have the fewest limitations; and to unction more effectively than most as a positive aid to instrument practice. That system is the blue-amber filter et-up.

To use blue-amber panels properly, t is necessary to know the functionng of the system. If the equipment s used correctly, the pilot can get more out of his instrument flying ractice.

Most varieties of blue-amber work retty well. But they work well only hen the blue and amber filters are orrectly matched. Even if the materials come from the same source, ocasional difficulties may be experinced. By chance, there may be very ight amber panels in the airplane at he same time the pilot is equipped ith very light blue goggles. With oth panels being light, the pilot will e able to see through the combination. If the panels are very dark, the pilot will have to strain to see the instruments.

In using the combinations, if the pilot sees too little or too much, either the panels or goggles should be changed. Usually it is easier to change the goggles.

During the time of increasing light at dawn or of decreasing light at dusk, blue-amber equipment should not be used.

Even if the light *seems* to be sufficient, don't use the amber panels at dawn or dusk. It is hard to judge the light at these times. A mistake in judgment may result in one more demonstration that two bodies cannot occupy the same space at the same time. The same advice applies for an overcast day. Best rule of thumb is if in doubt, don't use it.

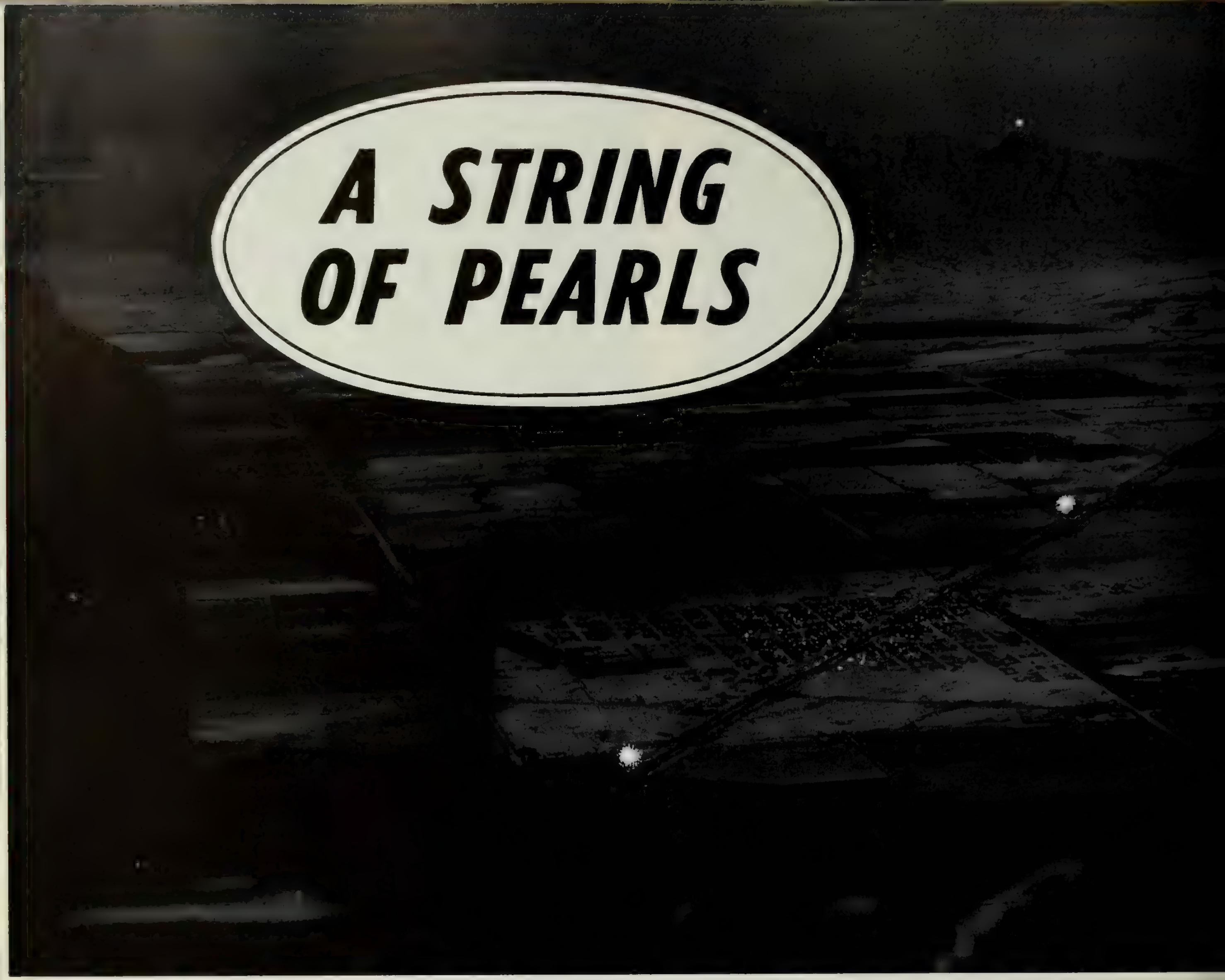
Most common trouble with amber panels is a scratched surface, or cracks. The scratches bend light rays and thus distort vision; if many scratches appear in a particular area, vision may be reduced below safety.

Probably the most neglected difficulty with the panel system is just plain dirt. A little work with a cleaning rag may double the efficiency of the system. The amber panels should be carefully inspected before being used.

In landing with the filter system installed, where the pilot has to estimate distances closely, vision should be through the amber of the clear sections only. It might be a better idea to have amber panels in all the cockpit windows.

A great many pilots do not like to land their plane with the panels installed, while some others make "amber-in" landings as a matter of routine. With a little practice, these pilots say, it is easy. But regardless of which system is used — helmet, hoods, louvres or filters, the pilot should be able to see, or transition, quickly to clear vision because some day he may have to do it without any warning. ●

# A STRING OF PEARLS



**The light line is a double check on night pilotage; every beacon tells its own story about your position.**

ONE of the loneliest flights in the United States is the run from San Francisco to Salt Lake City. You're on Green Three, eastbound through the Donner Pass at 11,000 feet. You're in spirit only, the night that covers you is black as the inside of a hat, the horizon non-existent.

Under you, desolation, mountains and wasteland, are jeweled here and there with the neon rubies of desert outposts. The ADF needle is on Reno and you flick the jack box to "Range" to get the station signal. It comes through five by five...*RNO*...*RNO.*

Out in front of your windshield, slightly to the left of course, stretches the reassuring light line, the life line of beacons that mark the airway, each flashing its code, each code telling a story to the pilot in terms of position and distance.

All civil airways are marked at night by these beacons, spaced at intervals of ten miles. From the air, they form an on-course light line normally seen from twenty to forty miles, depending on the visibility. You find these beacons marked on your aeronautical charts by a star with an open center. The little arrows on each side of the star indicate that the beacon has directional course lights, showing the direction of the light line. Although most pilots know that these beacons flash a code, only the savvy ones realize that each code is a message. The letter flashed in code shows the distance in miles from the origin of the airway.

Beacons are numbered from *west* to *east,* and from *south* to *north* between terminal cities. The numbe the beacon flashes, multiplied by te gives the mileage from the airway origin. For example, beacon Numbe One is ten miles from the origin o the airway, and beacon Number Fiv is fifty miles from origin.

The beacon number is identified b a letter flashed in Morse code. Th first letter of each word in the ke sentence corresponds to the numbe given with it. The key sentence to remember is "*When* (1) *Undertakin* (2) *Very* (3) *Hard* (4) *Routes* (5) *Keep* (6) *Directions* (7) *By* (8) *Good* (9) *Methods* (10). Because onl ten letters are used, it is necessar that the same letters represent th numbers of beacons more then 10 miles from the origin of the airway The number of a beacon that is mor than 100 miles and less than 1000

**Navigators know the letter flashed in code by a beacon shows the distance in miles from origin of the airway.**

**Out in front stretches the light line that marks the airway, each beacon telling the pilot position, distance.**

miles from the origin of an airway is a two-digit number. But the code letter flashed by the beacon represents only the last number of the mileage code. Thus the letter "W" is the code letter for beacons numbered 1, 11, 21; which are respectively ten miles, 110 miles and 210 miles from origin.

The series of code letters is repeated for each 100-mile section of the airway, and the only thing that you need to worry about is keeping in mind which section of the airway you are on. You normally do this anyway if you are in the habit of keeping your head out of the cockpit . . . literally and figuratively.

Airway beacons show six clear flashes per minute. These can be seen from any heading. But the identifying code signal, sent out between the clear (white flashes, can be seen only if you are on course. If the beacon is located on an airport, the code letter is flashed in green, if off an airport the signal is flashed in red. As a navigational double check, the corresponding code signal of the beacon, and the number of the beacon are printed on your aeronautical chart beside each beacon symbol. For daytime identification, the number of the beacon is painted on the roof of the little power shed close by each beacon structure.

These light lines, like other navigational aids, are established and maintained by the Civil Aeronautics Administration for the airline captain, the military pilot, and the civilian flyer. They form a network linking all important points in the country, and reduce navigation problems to standardized methods which work any time and any place, and under all weather conditions.

The catch is that too many pilots fail to use these navigational aids to the fullest extent. This all boils down to one thing . . . preflight planning. Plan your flight and fly your plan, and you'll never miss your ETA by too wide a margin. ●

★ ★ ★

*As we go to press, word comes from the Civil Aeronautics Administration that of the 2400 airway beacons now being operated on airways, all but 900 are being phased out. Beacons will now be spaced 20 to 50 miles apart, and the primary purpose will be to denote passage through mountainous areas. No information is available on any code change.*

# *REVIEW THE* ILAS

**By Maj. Robert Anderson, Communications and Navigation Lab, WADC, Air Research and Development Command**

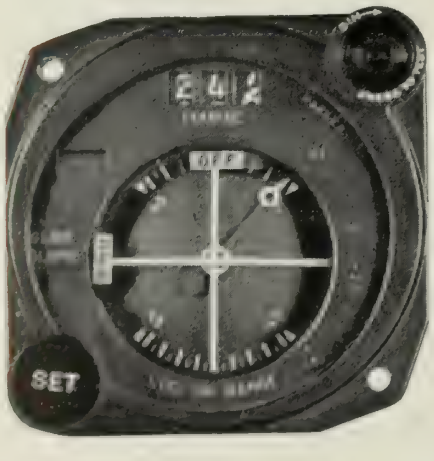
I'LL BET WHEN YOU SAW those letters at the top of this page, you said to yourself, "NO, not again!" and started on to the next article. The truth of the matter is, "Yes, Again!" and if you will put your feet on the desk, I'll try to break it to you easily.

You middle-aged fly-boys can vaguely remember a cross-pointer located on the old instrument panels which could be used to get the airplane close to a runway for landing if you were pretty sharp on the gages. You also remember that the instrument was half yellow and half blue.

If you flew away from the transmitter, blue was on the left, and if you flew in, blue was on the right, or vice versa. If the equipment was inoperative, the needle indicated that you were right on course, which caused more than one good jockey to clobber in.

Recently I noticed an advertisement in the *Saturday Evening Post* which almost made love to this system because of the number of commercial planes being landed safely with it.

OK, we all know that the airlines use it, but we also know that ILAS is the exception rather than the rule in the Air Force and that we are equipped for GCA, so why another batch of words on that antiquated approach system? Here is the reason—Oh, before going on, do you remember those roller coaster glide slopes and those mountain road localizers? How could you forget! If you don't remember this approach system, you had better get busy and learn. An article in the June, 1952, issue of FLYING SAFETY, describes this system very well.



### USAF Schedules ILAS

The Air Force has ILAS equipment scheduled at most of its major bases; however, it is not the same old hardware mentioned in previous paragraphs. The official designation of the new localizer transmitter is AN/MRN-7, and it has taken the "mountain road" and changed it to a "bee line." Similarly, the new glide slope transmitter, the AN/MRN-8, has changed the "roller coaster" into a "chute-the-chute." Both units are in production.

So what! you say—they have a straight approach path in the sky but I still have to be an expert to fly it, and besides it's easier to call GCA.

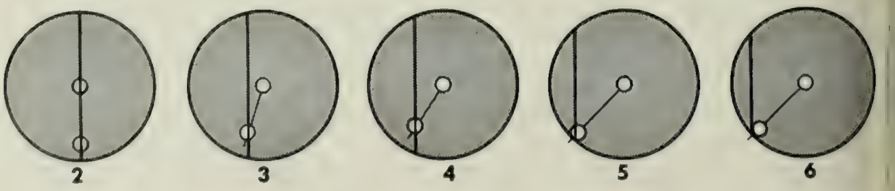
Now, I'll clue you again. By this time you all know about and have done much flying on the omni-ranges and the instrument you used may have been the ID-249, which is illustrated. This instrument, when fed information from an omni receiver, permits an aircraft to approach any chosen bearing to or from a station without overshooting. The same applies to a localizer for an ILAS approach. No overshoot, no bracketing. Not bad! This applies only to initial turn on course, but it is a big improvement.

### Set Up Heading

All you do is set the runway heading on the course indicator and turn into the localizer in such a way that the circular pointer of the heading indicator remains under the course needle. Then you slide down the chute to a landing. You really don't have to be a brain to make this stuff work. You can find out more about the ID-249 and how to make it work for you in AN16-30, ARN14-3.

This is not a joke. If you love life and want to give yourself every chance to maintain it, you should do some serious practice on this system. As stated before, it will be installed in the near future at major bases and if you're smart, you'll be ready to use it. The sweat disappears from your brow when you are in the soup with the needles centered and at the same time GCA says you are right on course and glide path and then the GCA man compliments you for an excellent run. It is a terrific feeling of security when you have two

**With the runway heading set in the course window, figures 2-3-4-5 show the pilot he's lined up for a good landing.**



systems and can cross check their accuracy.

So much for the basic ILAS.

Now let's talk about a few frills—those of you who have flown them will never stop extolling their merits.

First, let's add a Flight Computer, which is the Air Force name for Zero Reader. This instrument thinks ahead of the pilot and is superhuman in its performance. Any beautiful blond secretary can fly a perfect approach to within 50 feet of touchdown without losing her nail polish, and a pilot can do the same, using only two fingers of one hand to control the aircraft simply by flying two needles. This sounds like hogwash and no amount of words can make the uninitiated believe it; however, one flight will convince anyone that *this is it!*

### Two Flight Computers

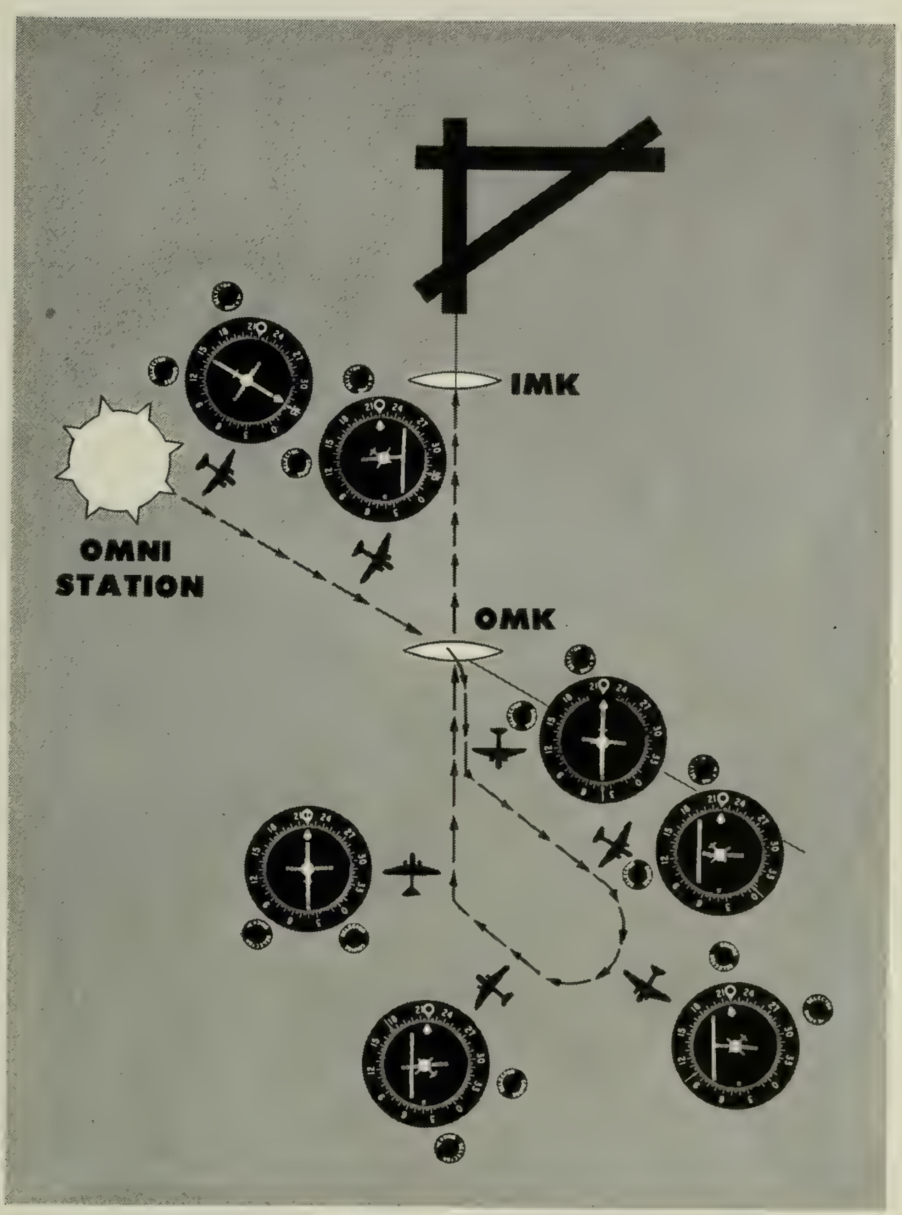
There are actually two flight computers available. One is the common Zero Reader, and the other is called the Integrated Flight System. Both give nearly the same information but in different ways and each has its good points. The Integrated Flight System has an indicator in addition to the cross-pointers which draws a picture simple enough that even I can fly it.

That is a very brief summary of the semi-automatic approach systems and now all we do is tie-in the autopilot and we have an automatic approach. Of course, you still have to jockey the throttle, but not much, and you have two free hands to use if you need them. Just sit back and watch the airplane land itself by using a sky beam for a guide.

It all boils down to this:

ILAS is not going—it is coming. So practice its use every chance you get and you will find that you will be so sold on this approach aid that you will call for it by brand name!

★ ★ ★



**The chart illustrates the flight system for interception of localizer course. The pilot has at all times a graphic indication of his position.**

*Editor's Note* — Flying Safety *contends that both ILAS and GCA are excellent approach aids, but that neither can be construed as landing aids. The limitations of both systems must be evaluated by the pilot.*

*Many pilots contend that they prefer ILAS because it keeps control in he cockpit, yet the average run-of-the-mill pilot has a hard time keeping the needles centered unless he practices constantly. In addition, the pilot who attempts to fly the ILAS must have a thorough understanding of the system, and how it is laid out "on the ground." He must understand the marker system and the marker code, and he must interpolate the dots on the dial for proper orientation.*

*On the other hand, GCA requires only a minimum of radio receiving equipment, and a pilot need only know his proper power settings, and his correct attitude on the flight indicator to follow instructions from the GCA controllers.*

*Those in the know, maintain that the perfect set-up is a combination of ILAS and GCA, one acting as a safety factor for the other.*

*Don't sell either system short. They are both excellent, and are both proven . . . and are continuing to improve every year.*

*For a review of both these systems, Air Force Manuals 51-37 and 51-38 are highly recommended. Read the manuals until you understand the theory, then go out and practice your ILAS every time you get a chance . . . and GCA, too, for that matter!* ●

# SLIPPERY WHEN Wet

DURING the summer months of the past two years there have been many major aircraft accidents in which the principal factor was a wet, slippery runway.

The discouraging part of this story is that in the majority of these instances. the accident could have been avoided by the use of good judgment on the part of the pilot. Every one of these accidents involved an element of sloppy planning, failure to go to an alternate, poor airspeed control or final, failure to obtain complete weather information, failure to heed tower advisories, or improper traffic separations.

Snow and ice are one thing, and under abnormal operating circumstances, much can be forgiven. But rain is something else again, specially when the pilot knows the landing roll minimum of his airplane, and still tries to luck in a landing without sliding into the mud on the shoulders or the overrun.

Looking over the imposing array of mishaps charged up to wet or slippery runways, we find the good B-26, like Abou Ben Adhem, leading all the rest. Except fighters, that is. The F-80 and F-84 divide top honors in this weight and class. In the cargo field, strangely enough, the C-54 takes the brass ring; with the Great Grey Gooney back in the field, running a weak second.

Let's look over some of these weird tales that drift in, via the Form 14.

Here is one of the leading contenders in the daffiness derby. It concerns a B-26 that was cleared out of Alpha AFB to Beta AFB on a ferry mission. In addition to the ferry crews whose mission it was to pick up aircraft at Beta, there was a navigator aboard, and this gentleman evidently strapped himself in the nose upon takeoff and remained there until the climax of the fiasco, taking with him a mighty crick in his back as a memento of the occasion.

Although all aboard had safety belts fastened, there were only two sets of shoulder harness (pilot and right seat), and these were not hooked up. In addition to these discrepancies, a goodly portion of the three-hour flight was made at 11,000 feet, yet at no time was the pilot or copilot on oxygen. This was not only a lapse in good operating procedures, but was in violation of AFR 60-16, which says that when the cabin pressure is above 10,000 feet, oxygen will be used. It also encourages the use of oxygen when the cabin pressure is 8,000 feet or above. Sure, we know *you're* a superman . . . but *maybe* a little oxygen would have sharpened the wits of this pilot. The entire flight was made at night.

Well, anyway, the pilot filed his clearance. supervised by an IP, was thoroughly briefed on the inflight and approach procedures from Alpha AFB to Beta AFB by the operations officer at Alpha, and took off.

When the pilot arrived over destination some three hours later, he called for a GCA, and was cleared down to 1500 feet. At this time, the pilot was advised that the runway was 7,000 feet long, 2,000 of which was pierced steel planking.

Under wet conditions, this offered the pilot 5,000 feet of "usable" runway, because pierced steel planking is famous for its poor braking qualities. He was advised that the surface of the entire runway was slick, and that he should use caution. The pilot let down through the stuff at 150 indicated, broke contact at 900 feet and after dropping full flaps, slowed to 135 indicated.

However, the touchdown was made approximately 1500 feet inside the boundary lights, which gave the pilot only 3,500 feet of runway that was not pierced steel planking. It doesn't take a red-hot B-26 pilot to calculate that this is a pretty short piece to slow up an airplane at 32,000 gross on a slick surface, pierced steel planking or anything else.

Before the pilot knew it, he was past the far-end threshold lights and on the pierced steel planking, which was slicker than a cat's back. Brakes were applied judiciously, but before anyone could say Orville Wright, the beast was through the fence at the far end, and in the position of an abrupt stop.

A recording of the GCA transmission indicated that at one mile out the airplane was sixty feet high on the glide path, and the pilot was advised by the controller to go around. But, he elected to try and make it in.

Summing up this tale of woe, it is pointed out that in the first place, the mission was not of an urgent nature. His alternate was nearby, with good runway surfaces, and the ferry crew could have been easily transported from the alternate to Beta.

Secondly, the pilot (and the IP) elected to make a landing on a runway, the length of which would have been marginal under normal conditions for this type of aircraft, after having been advised that the runway surface was wet and slippery.

From a supervisory standpoint, there was no established S.O.P. for short, wet runway landings; and there was no Notam in the files covering runway conditions at Beta under inclement conditions. However, the crew was advised in good time of the slippery runway, and could have proceeded to an alternate. For training purposes, GCA could have been worked out a full-stop landing.

Under any circumstances, it is apparent that neither the pilot nor the IP were familiar with the Dash-One on minimum landing distances. The primary cause of this accident was chalked up to wet runways, but the accident could have been avoided with a slight fall of pride, and a detour to the known good alternate. There were no fatalities, and only one minor injury . . . but scratch one Baker Two-Six!

In still another instance, a gaggle of F-80's was taking off when the leader got into trouble and jettisoned his tiptanks on the runway. The tanks ruptured and fuel was spilled in quantity an the runway surface. The following aircraft tried to abort in time to miss the aircraft on the runway ahead of him, and slid into the oily fuel. Although there was some braking action, the aricraft slid very slowly over the shoulder of the runway into the sod.

Here is a case of an unavoidable accident, except for the fact that the leader might have aborted his takeoff, instead of trying to make the takeoff sans tiptanks. It proves one thing . . . fuel on the runway is *mighty* slippery!

Not long ago a fighter outfit was working a European airfield where no wind direction and velocity indicator were installed. Just after the flight took off, the tower reported a thunderstorm approaching the field, and advised the pilots to return. All but two of the pilots returned to the field. A few minutes later, feeling that discretion was the better part of valor, the remaining two decided to come in.

The tower operator had guessed at the wind direction and velocity and guessed wrong. However, the pilot of the last airplane in, instead of noticing the difficulty the preceding pilots had in landing, elected to make a normal approach, and came in hot. He made a go-around and came in hot again. He made another go-around, and finally made up his mind to land, which he did at some 150 knots. Although he hit on the "numbers," he used so much brake that his F-84 burned out the left tire, and slid the entire length of the runway plus 200 feet into the far over-run. This pilot did not use good judgment, evidently panicked a mite and certainly did not know his wet-runway landing procedures.

### Round Robin

In still another instance, four F-84's were cleared from Dazzle AFB to Zuni AFB on a round robin. All four aircraft were serviced with full external fuel loads so as to make the round trip without refueling. When the flight came over Zuni Tower, the leader was advised by the tower that the surfaces of the runways were extremely slippery.

The leader flew around the area for a short time at 90 per cent power until his tiptanks were empty. His Number Three man then reported that he had 3000 pounds of fuel remaining. The flight leader entered traffic, made a wide power-on pattern, and touched down "on the numbers" at 140 knots indicated.

As the nosewheel touched down, the flight leader tested the braking action, but his ariplane only started to skid. At this point, although the tower had previously advised the entire flight, the flight leader informed the rest of his flock that the runway surface was slippery. The flight leader skidded off the far end of the runway, into the over-run . . . skidded the entire length of the runway. By this time the Number Two man had touched down, and he, too, was unable to stop his airplane in the length of the runway, colliding with the flight leader's tiptank.

The primary cause of this accident was lack of control of the aircraft due to slippery runways, causing the flight leader to lose directional control, and the wingman to slide into the flight leader.

At this time we should like to call to your attention a source of information on the subject of this piece. It is commonly known as the Dash-One. Back in the appendix, (Appendix I, to be exact) is a flight operating instruction chart, titled, "Takeoff, Climb, and Landing Chart." At the bottom, under "Landing Distance," is a chart showing the ground roll of your airplane under proper power settings at sea level, and 3000 feet and at 6000 feet under "wet or slippery" conditions.

For instance, on the Gooney, your ground roll with 26,000 pounds gross, at 75 knots, at sea level, will be 4000 feet. That means that on a 5000-foot runway, you've got to touch down before you hit the 1000-foot mark, or you'll be right at the far end when you stop rolling. Add to this the possibility of a tailwind, poor visibility, and mud, oil or fuel droppings on the runway, and you can easily see why it takes plenty of pre-planning to make it in safety on a wet, slippery runway.

The remedies for these accidents are not complex. The basic remedy is clear thinking. In addition the pilot must know the limitations of his aircraft when it comes to a landing roll, especially on wet runways. If in formation, spacing should be let out considerably. Supervisors should ascertain if the control tower has up-to-the-minute information of runway conditions, and NOTAMS must be kept up to date where known slippery runways exist under wet conditions. It's a manifestation of that wise saying, "The best safety device is between the pilot's ears." ●

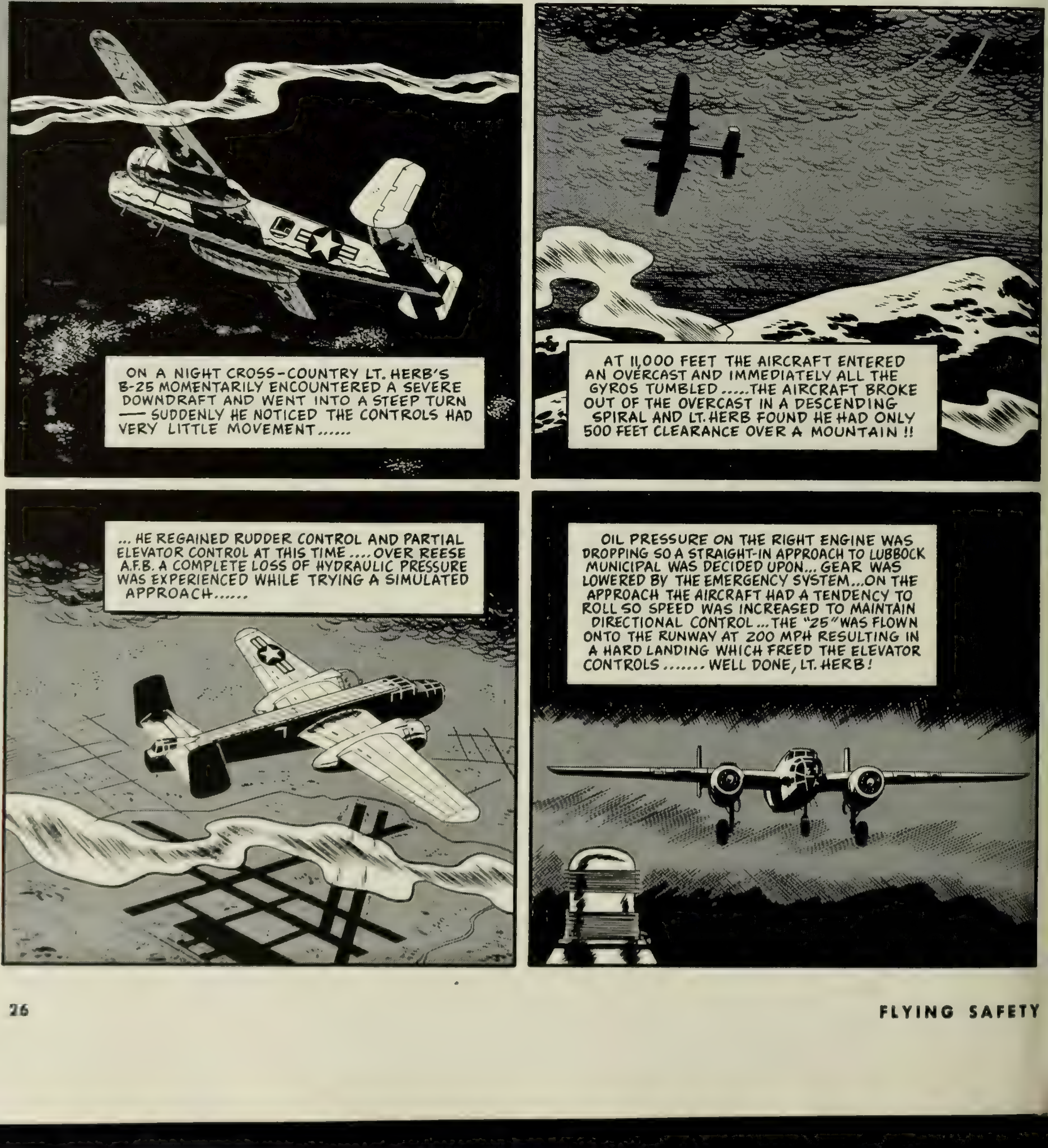
### L'ENVOI

*The approach was hot*
*The runway wet*
*If it wasn't for the fence*
*He'd be rolling yet!*

# WELL DONE!

## to 1st Lt. Donald P. Herb, Jr.

*After encountering severe turbulence which caused foreign particles to jam all controls of his TB-25L, Lt. Herb kept a cool head to make a successful landing with no damage to the aircraft. Later inspection of the plane showed numerous bolts, nuts, screws, rivets, etc., around control cables throughout the plane. The aileron cables had one-half wrap around each other, and the aileron trim tab cable was off the pulley in the right wing, all of which were contributing factors to bring about the emergency.*


ON A NIGHT CROSS-COUNTRY LT. HERB'S B-25 MOMENTARILY ENCOUNTERED A SEVERE DOWNDRAFT AND WENT INTO A STEEP TURN — SUDDENLY HE NOTICED THE CONTROLS HAD VERY LITTLE MOVEMENT......
AT 11,000 FEET THE AIRCRAFT ENTERED AN OVERCAST AND IMMEDIATELY ALL THE GYROS TUMBLED.....THE AIRCRAFT BROKE OUT OF THE OVERCAST IN A DESCENDING SPIRAL AND LT. HERB FOUND HE HAD ONLY 500 FEET CLEARANCE OVER A MOUNTAIN !!
... HE REGAINED RUDDER CONTROL AND PARTIAL ELEVATOR CONTROL AT THIS TIME .... OVER REESE A.F.B. A COMPLETE LOSS OF HYDRAULIC PRESSURE WAS EXPERIENCED WHILE TRYING A SIMULATED APPROACH......
OIL PRESSURE ON THE RIGHT ENGINE WAS DROPPING SO A STRAIGHT-IN APPROACH TO LUBBOCK MUNICIPAL WAS DECIDED UPON... GEAR WAS LOWERED BY THE EMERGENCY SYSTEM...ON THE APPROACH THE AIRCRAFT HAD A TENDENCY TO ROLL SO SPEED WAS INCREASED TO MAINTAIN DIRECTIONAL CONTROL ... THE "25" WAS FLOWN ONTO THE RUNWAY AT 200 MPH RESULTING IN A HARD LANDING WHICH FREED THE ELEVATOR CONTROLS ....... WELL DONE, LT. HERB!

# Keep Current

NEWS AND VIEWS

• **New Rocket Rack** — Launched rom a rack that snaps back inside he fuselage a split second after fir-ng each of the twenty-four Mighty Mouse 2.75 rockets of North Ameri-can's F-86D is capable of knocking down the biggest enemy bomber. Each rocket's punch is that of a 75mm shell. This new version of the Sabre is the AF's only one-man, all-weather nterceptor. The plane holds the world's speed record—698.5 mph. It has more electronic gear than an average TV station.

• **Slower Comedown**—A new non-oscillating parachute, with flaps to nsure better stability, has been de-signed and tested by the Wright Air Development Center, Dayton, Ohio. The flaps, WADC explains, will also check a jumper's rate of descent and educe opening shock. The chute, which can be used at speeds bettering 400 mph, will be manufactured by Pioneer Parachute Co., of Manches-er, Conn.

• **Raft Hangup Incident**—Earlier his year, during the Netherlands loods, a C-119 was dropipng six-man ife rafts to aid the victims below. Because of the lack of CO-2 bottles, he rafts were inflated before takeoff, nd loaded into the cargo compartment.

The airplane was flying at about 50 feet off the deck, when a raft ouled the elevator stabilizer in the rocess of being jettisoned, and re-mained in a vertical position, facing he nose of the aircraft.

The C-119 vibrated violently, re-uiring both pilot and copilot to ang on to the controls. Repeated at-tempts failed to dislodge the raft. However, the pilot discovered that if e reduced his airspeed to 90 knots, e could fly the airplane, although here was a noticeable porpoising ction. By maintaining this airspeed e was able to make a nearby base, nd completed a safe landing.

**Guard New Frequency**—Re-cently all CAA control towers and communications stations established a listening watch on 3023.5 kc, replacing the 3105 kc. Use of the new frequency will eliminate interference from tropical broadcasting stations and other sources that have made it difficult for CAA to give good service in many parts of the country.

CAA facilities will continue to guard 3105 kc for one year after implementation of the new channel. The present listening watch on military frequency 4495 kc. will be discontinued.

The change from 3105 kc. to 3023.5 is but one step in a world-wide program which involves rearrangement of almost the entire high frequency spectrum, as planned by the International Administrative Aeronautical Radio Conference and approved by the U. S. Government.

The program is designed to make use of all frequencies more effective by eliminating or reducing to a minimum interference from both co-channel and adjacent channel users. The overall plan will benefit aviation and pilots by providing for the first time in history, exclusive frequencies for aeronautical use.

• **B-2 Plotter Error Found**—Captain K. D. Bundy, Navigation Instructor in the 3640th Pilot Training Group, Laredo AFB, Texas, has eyesight that is sharper than somewhat. Captain Bundy has discovered an error in the B-2 plotter which could develop into a contributing aircraft accident factor if the B-2 was used as designed.

Says Bundy: "The scale on the B-2 plotter is identified as follows: 'Scale 1:3,000,000 nautical miles USAF long range navigation chart.' This is not a valid unit of measurement, as the Long Range Navigation Chart is on a Mercator projection, and the scale of miles on this chart is continuously variable with the latitude change."

An example of the error can be found by measuring distance on a rhumbline course from Paine AFB, Washington, to Hill AFB, Utah, using the long range navigation chart No. LR 10 (revised June, 1952). The correct distance measurement is 603 nautical miles, while the B-2 scale distance measurement is 541 nautical miles. In this particular case the error is 63 nautical miles, or 10.42 per cent. This percentage of error will decrease in lower altitudes, but will increase in higher latitudes.

• **Radar Trainer**—Development of a revolutionary new device for the bombardment and navigation training without actual flight of aircraft observers of Air Force aircrews has been announced by the Air Research and Development Command.

With this ultrasonic (above the speed of sound) radar trainer, identified as the AN/APQ-T1, future aircrews will be able to become familiar with flight problems, including targets, anywhere in the world while still on the ground in this country. It was designed and built for the U. S. Air Force by American Machine and Foundry Company's Electronics Division, Boston, under the supervision of equipment technicians at the Air Research and Development Command's Wright Air Development Center, Dayton, Ohio.

The equipment will provide the Air Force with the type of advanced training required to cope with the problem of providing skilled aircrew personnel for high performance aircraft operating at extreme speeds and altitudes. It offers advantages which will expedite Air Force training programs. These are: increased safety in training due to the reduction of required flight time; increased utilization of training time resulting from use of the device on a shift basis and for the simultaneous training of the students involved in the bombing problem; reducing training expenses by releasing aircraft and personnel for other duties, and increased effectiveness of personnel trained with this device.

# Cross Feed

## flying safety idea exchange

### Looks Forward to Flying Safety

The editorial section of this bureau looks forward each month to seeing Flying Safety . . . we glean ideas from it for . . . our publications.

**1/Lt. William P. Kelly**
**Editorial Director, War Dept.**
**Recruiting Publicity Bureau**

• • •

### Cold Weather Aid

Matters pertaining to cold weather flying (appearing in Flying Safety) were a great help to this section in preparing this Wing for the "Snowfall Maneuver."

**Carl Mosely**
**Captain, USAF**
**435th Troop Carrier Wing**

• • •

### Privilege to Read

On numerous occasions I have had the opportunity to read . . . Flying Safety. This magazine certainly contains a lot of interesting information for those of us who are in the flying business . . . We would consider it a privilege to receive regular copies of Flying Safety.

**R. W. Richardson**
**Assistant to the President**
**Goodyear Tire & Rubber Co.**

• • •

### Deserve Well Done

All of us here look forward to each new issue of Flying Safety magazine. We feel that your staff deserves a Well Done!

**C. B. Cosgrove**
**Colonel, USAF**
**Commanding**
**4860th Photo Group**

• • •

### From Chile

In the units and bases of the Chilean Air Force, the officers have read with great interest copies of Flying Safety.

**Gregorio B. Rubio**
**General de Brigada Aerea**
**Comandante Unidades Aereas**
**Santiago, Chile**

### Used in Training Program

"Flying Safety on The Airways" is considered to be the most complete and one of the most popular articles published by the Directorate of Flight Safety Research. It has been extensively used in our flight training program to improve techniques

**Millard A. Libby**
**Colonel, USAF**
**Chief of Staff**
**Atlantic Div. MATS**

• • •

### Enthusiastically Received

I want to say that the Flying Safety magazine is reviewed with much interest by this Command.

**L. P. Whitten**
**Major General, USAF**
**Commanding**
**Northeast Air Command**

• • •

### Vital Information

I have been receiving your excellent magazine, Flying Safety and want to express my appreciation . . . it is well done and contains much vital information for ground and flight personnel.

**Norman H. Osbourne, R.N.**
**Aero Health & Safety Unit**
**Pratt & Whitney Aircraft**

• • •

### Outstanding

First and foremost your staff deserves plaudits for continually publishing the outstanding magazine in the aviation world. Flying Safety has for many years been publishing timely articles in an easily remembered style.

**Clyde G. Miller**
**Major, USAF**
**67th Tac Reconn Wing**

• • •

### Use Techniques

We not only taught all our pilots and flight mechanics the procedures you've outlined . . . (How to Check an Engine) but we are now using them in our schools for the Transport Squadron, Imperial Iranian Air Force.

All flight crews await with eagerness the arrival of Flying Safety.

**Francis L. Grable**
**Col. USAF**
**Senior Air Advisor to Iran**

• • •

### "Ol' Boreas"

Here at the 12th Air Rescue Group, Flying Safety is read each month with interest in search of new methods to promote flying safety. We are proud of our record of no accidents since the activation of our unit, over a year ago.

In checking the story "Ol' Boreas" in the February issue, we think that the author forgot to lapse the temperature in the illustrations and used standard temperature at sea level instead of at the 10,000-foot level.

**Lt. Col. John A. Carroll, Jr.**
**12th Air Rescue Group**

• • •

Ed. Note: *Colonel Carroll is keerect. The author and the editors are guilty of a lapse of more than standard temperature.*

• • •

### One Borrowed Copy

Many of the problems discussed in your excellent magazine are common to both Air Force and Navy Squadrons . . . much benefit and great enthusiasm on the part of this squadron has resulted from one borrowed copy.

**R. L. Werner**
**Commander, U. S. Navy**
**Fighter Squadron Eleven**

• • •

### ERRATUM

*Before we incur the wrath of some of the old Issoudoun gang, we hasten to apologize for the technical error on page 3 of May's "Flying a Flameout." In the days of the SPAD, we learn, this machine was equipped with a Hispana-Suiza mill, not a Gnome. The Gnome, that high-torquing little beast, graced the nose of the old Nieuport airplane.*

**The Editor**

# The Jungle is no Garden of Eden

If you're down in the tropics don't hit the panic button . . . those first few minutes you spend taking stock of your situation may mean the difference between getting out safely, or staying there forever.

From the moment you're on the ground, the steps to be taken in any survival experience may differ according to your particular condition and the terrain in which you find yourself. You've got it made, tropical hot or cold, if you keep your head and put your survival training into practice.

***Use Your Common Sense and Survive!***

# TIMES HAVE CHANGED

NOWADAYS everything's moving so fast, especially in the blue yonder, that we can't afford to sit back and rest on last week's knowledge.

Regulations involving flight of aircraft are being constantly revised, as are operating instructions, procedures, and T. O.'s. Your best source of information is your Flying Safety Officer. The chances are better than 8 to 5 that he'll have the latest information . . . for *your* safety!

***Look Ahead • Be Ahead • Stay Ahead with FLYING SAFETY***

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# FLYING SAFETY

**JULY** **1953**

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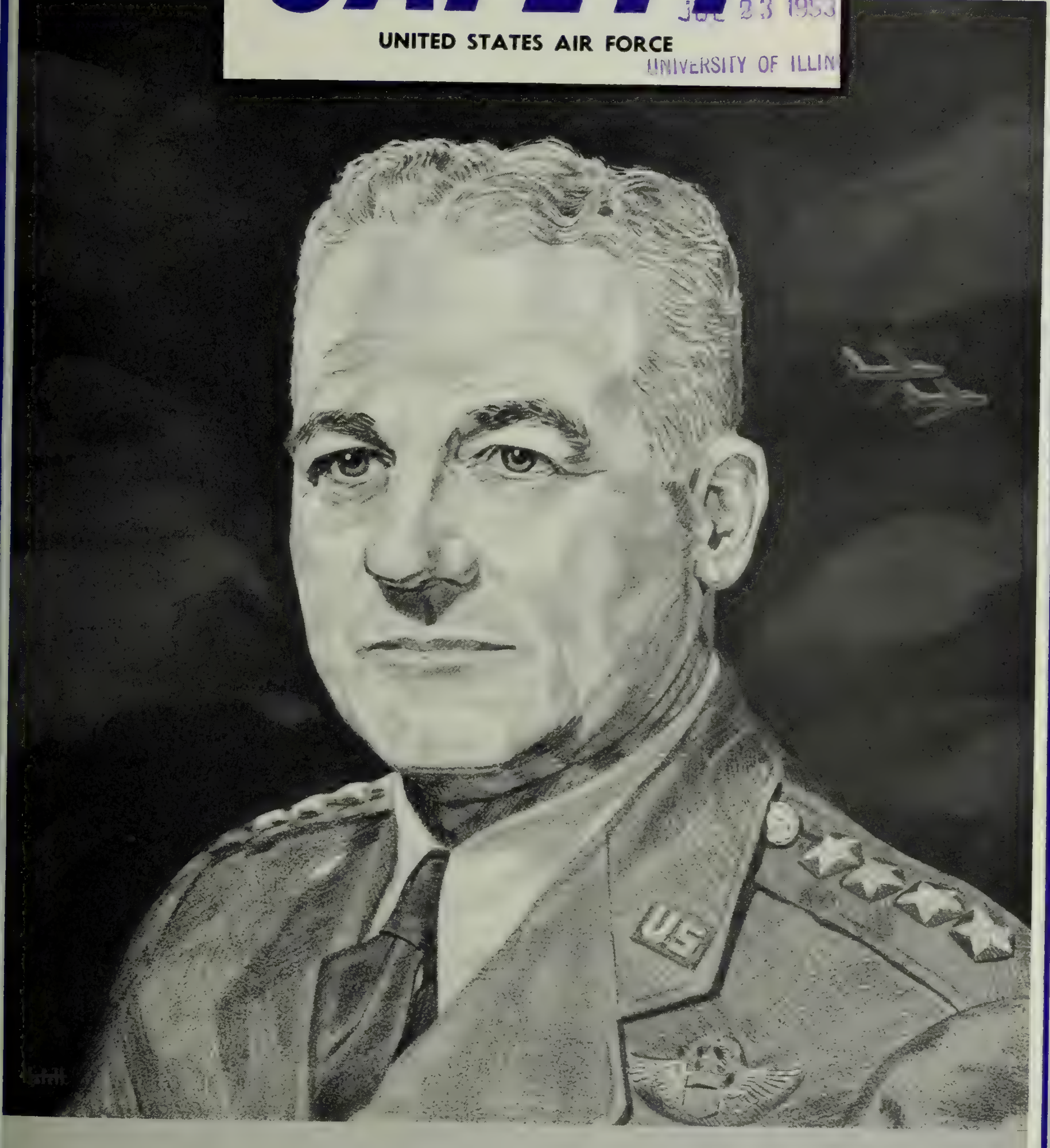

**GENERAL NATHAN FARRAGUT TWINING**
**Chief of Staff, United States Air Force**
**"An Airman's Airman"**

**LIEUT. GEN. THOMAS D. WHITE**
Vice Chief of Staff
United States Air Force

# LEADERSHIP

AIR FORCE leaders know the value of adequately planned and executed accident prevention programs. They know that the program, to be effective, must be followed through to the ultimate goal . . . elimination of unnecessary aircraft accidents.

The three most important considerations are:

1. Air discipline
2. Supervision
3. Control of the flying operation.

When unit commanders believe implicitly in the value of concerted accident prevention programs, and where they require the tenets of accident prevention to be enforced throughout the lower echelons, the net result in every instance, has been a reduction of aircraft accidents.

☆

***Look Sharp . . . Think Sharp . . . Be Smart with FLYING SAFETY***

Department of the Air Force
The Inspector General USAF
lajor General Victor E. Bertrandias,
Deputy Inspector General

★ ★ ★

gadier General Richard J. O'Keefe
Director
ectorate of Flight Safety Research
lorton Air Force Base, California

★ ★ ★

Colonel John R. Dahlstrom
Supervisor of Flight Safety
Publications

★ ★ ★

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printing of this publication has been ved by the Director of the Bureau of the et, June 4, 1951. Facts, testimony and sions of aircraft accidents printed herein been extracted from USAF Form 14, and not be construed as incriminating under e 31 of the Uniform Code of Military Jus- All names used in accident stories are us. No payment can be made for manu- s submitted for publication in FLYING Y magazine. Contributions are welcome e comments and criticisms. Address all pondence to the Editor, FLYING SAFETY zine, Deputy Inspector General, USAF, n Air Base, San Bernardino, California. ditor reserves the right to make any edi- changes in manuscripts which he be- will improve the material without alter- e intended meaning. Air Force organiza- may reprint articles from FLYING SAFETY ut further authorization. Non-Air Force izations must query the Editor before ting, indicating how the material will be The contents of this magazine are in- tional and should not be construed as tions, T. O.'s or directives unless so

VOLUME NINE
NUMBER SEVEN

# FLYING SAFETY

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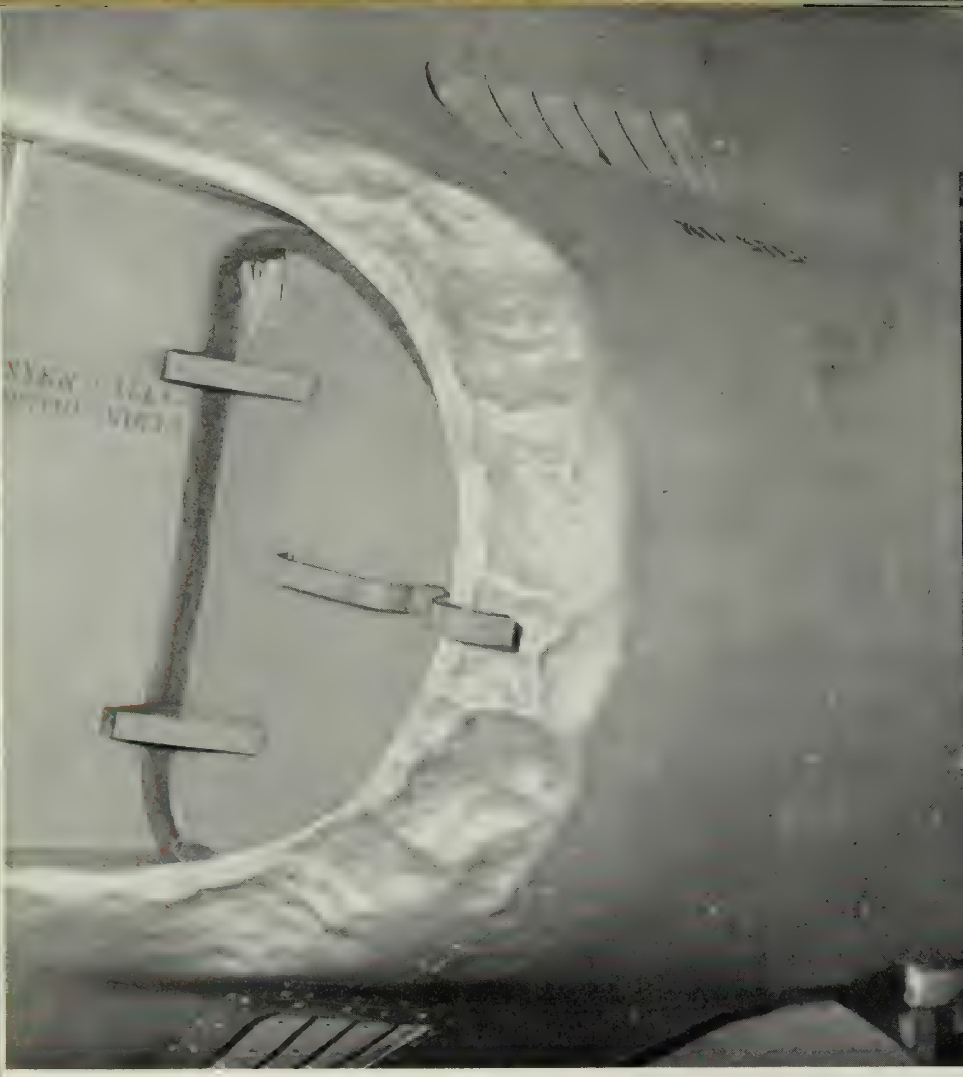
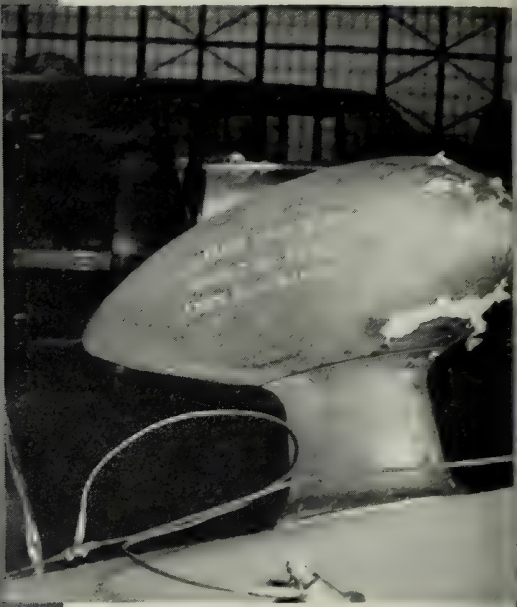
"The American designers favor the thin swept-back wing." (see page 16)

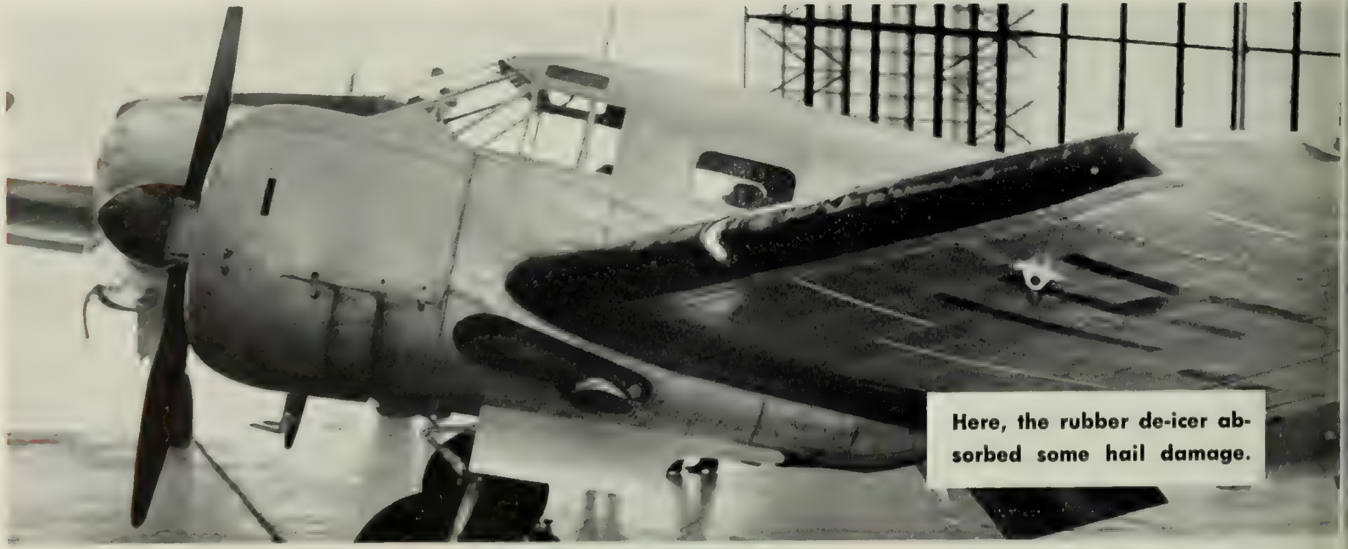




This antenna housing on a C-45 took quite a beating in a severe hailstorm.

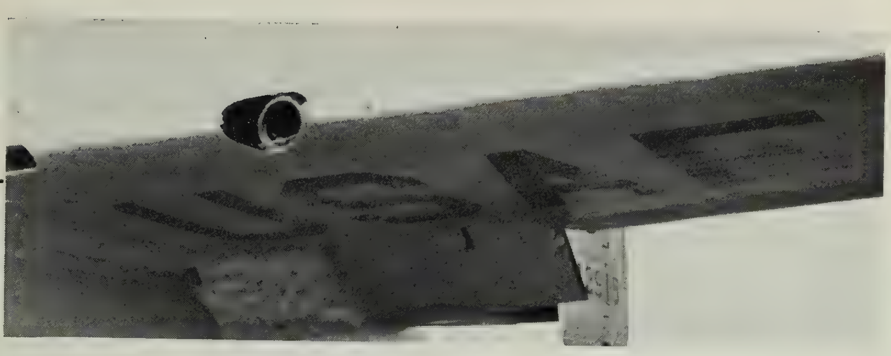
Note how the edge of this jet intake was badly battered by large hailstones.

# . . . . hit by HAIL!

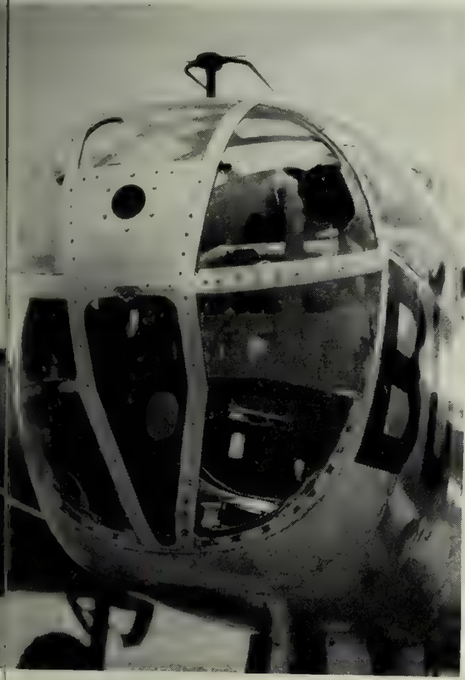


Here, the rubber de-icer absorbed some hail damage.

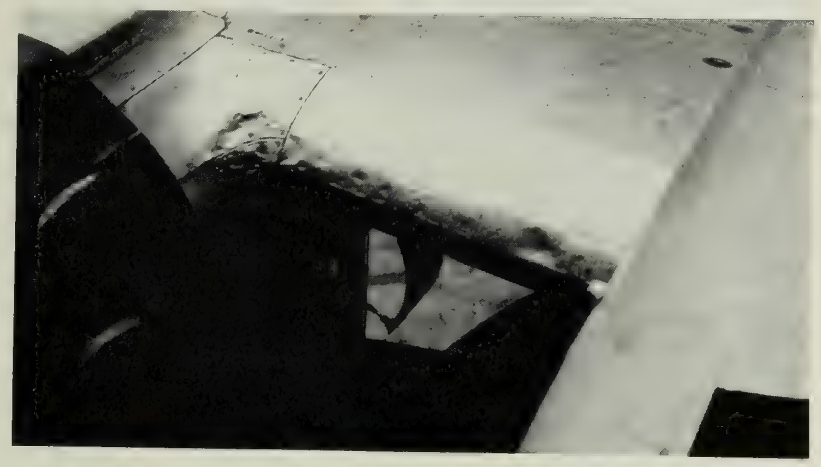
Top right photo shows B-25 landing light completely smashed by hail.



Heavy plexiglas in the nose of this B-25 was shattered in a hailstorm.



Heavy hail damage was incurred to this B-25 on both the leading edges of the wings between the two engine nacelles and the fuselage.



**Don't be caught with your flaps down—a good understanding of when and where hail forms will reduce your chances of running into unexpected hailstorms.**

ALTHOUGH USAF statistics show no airplanes destroyed or fatalities attributed solely to hail, this weather phenomenon has caused severe damage to aircraft, in some cases running as high as $25,000. Nose sections and wing leading edges ake the brunt of hail damage, and windshields have been cracked or broken to a degree that, at normal cruising speeds, could have caused broken glass to be blown into cockpit.

Research shows that the extent of hail damage to an airplane varies in direct proportion to the size of the hailstone, the impact velocity and the ype of material struck by the hailtone. It has been found that hailtones less than 0.75 inch in diameter cause little or no damage, but there are cases on record of airplanes running into hailstones as large as two inches in diameter, and these can and do cause heavy damage.

Although the USAF is making significant strides in the detection and interpretation of weather phenomena, including hailstorm masses by radar equipment, the successful avoidance of hailstorms is still dependent upon pilot judgment. In order to exercise good judgment, the pilot should:

☆ Be familiar with the occurrence of hail and the effect of hail on his aircraft.

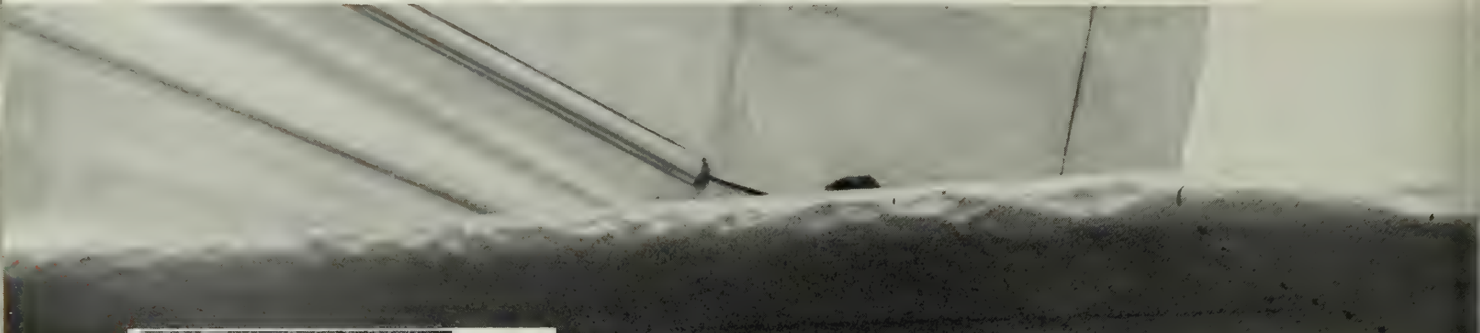
☆ Know the overall weather conditions before he leaves the ground on a flight.

☆ Be aware of the developments that can arise, and be able to evaluate them when he meets the emergency.

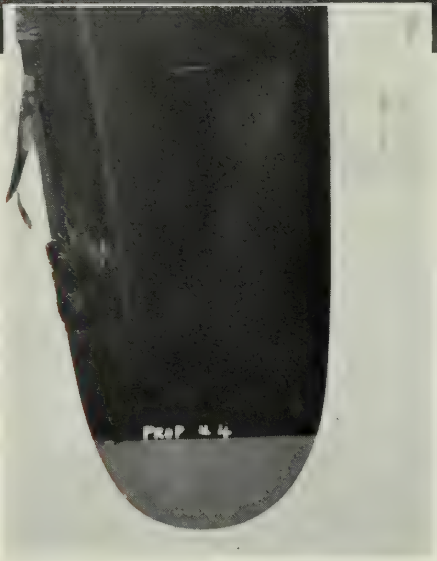
### Watch for Thunderstorms

You don't have to be a professional weatherman to have a good understanding of when and where hail forms, and the weather conditions associated with hailstorms. You should know enough about hailstorms, however, to discuss them intelligently with your forecaster, and to know what extra in-flight weather information you should have available. If you have this "gen" at your fingertips, the chances of running into hailstorms will be reduced.

If, in planning your flight, you



**Above is a close-up of a hail-battered leading edge of a horizontal stabilizer showing what can happen to a plane flown through a thunderstorm area.**



**Prop blades take their share of hail damage. Below, a large type hailstone punched through this wing edge.**

have a feeling that you may possibly encounter hail, you should keep a weather eye out for all thunderstorm clouds that are in line with, or directly adjacent to your course. Since you should know that the severity of a thunderstorm is associated with the stage of its life cycle (FLYING SAFETY, March, 1953, "Flying the Thunderstorm"), and since hail usually occurs in the mature stage of the storm, great caution should be taken when you are flying near or through this stage of the thunderstorm. You can recognize this mature stage because the storm will have a sharp-edged cauliflower appearance, with cloud-to-ground lightning. You can tell a storm in the dissipating stage by its wispy-edged appearance, and cloud-to-cloud, flickering lightning.

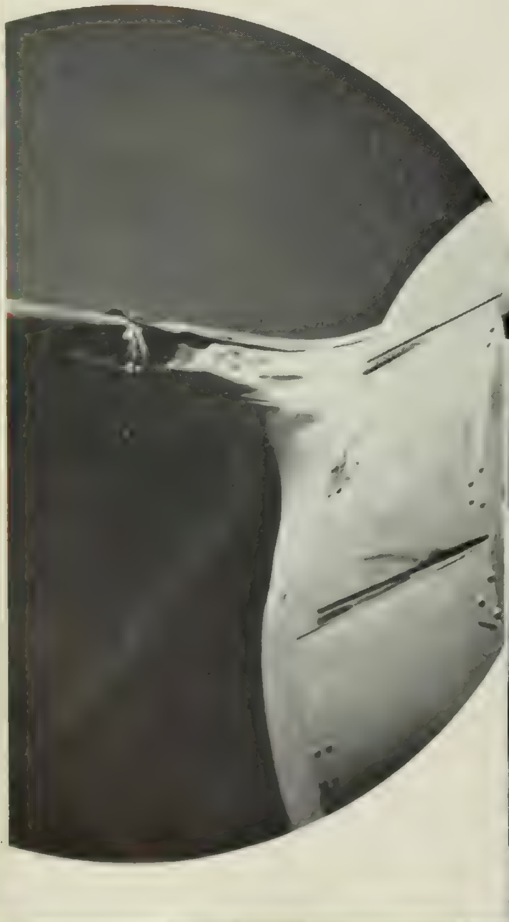
The chances of running into a hailstorm at night when visibility is low, is lessened by the fact that only 24 per cent of the hailstorms occur after the hours of darkness. Hail is usually a daylight phenomenon.

Many USAF pilots make use of visual soft spots when on IFR in cumulonimbus clouds. However, this method is not always reliable because hail has been reported in the clear air outside the storm clouds. It is advisable to stay away from cumulonimbus clouds when the temperatures at flight altitude are below freezing.

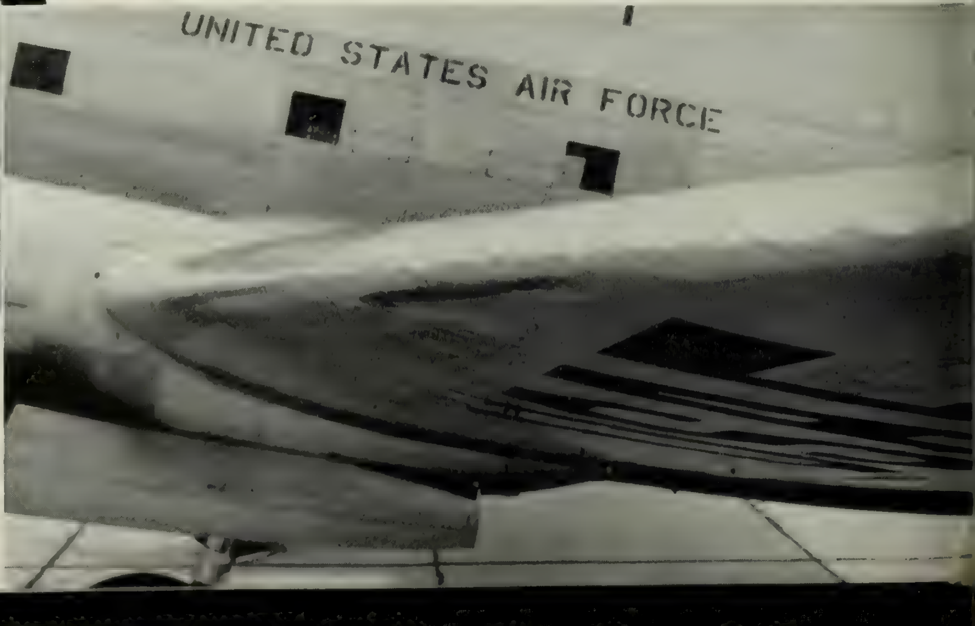
Remember this too, that although you may not encounter hail in one particular storm, you may run into a passel of it in another storm within the same general area, or at a different altitude in the same storm.

Should you enter a thunderstorm and encounter hail, you must decide whether you should turn to get out of the hail area, or continue through the hail on your original heading. Here again, pilot judgment comes into play, and your decision must be based on all the known factors regarding the position of the airplane with respect to the storm.

If your course is parallel to the edge of the storm, a turn is obviously



**Cold front hail severely pock-marked the leading edge of this C-47 wing.**



the best solution. If the relative position of the storm is unknown, the best course is to continue through the storm. This course is especially advisable under IFR conditions, poor radio reception, or where other adverse factors are involved. Remember also that the speed of your airplane has a definite effect on the hail damage you will sustain. You should reduce speed as soon as possible after entering a hail area.

### Forecast Judgment

In forecasting hail, a certain amount of judgment must be used on the part of the weather man. Probably the most important factor in the accuracy of hail forecasts is the amount of time the forecaster has been stationed in the vicinity. In general, the forecaster is able to detect potentially dangerous situations when he makes an area or route forecast.

During the preflight weather briefing he should always warn the pilot of the possibility of hail, when the signs are right for it. After the pilot has taken off, every effort should be made to transmit hail information to the pilot when inflight reports and surface observations indicate that hail exists, but was not forecast for the area. In other words, hail is extremely hard to forecast accurately, and the phenomenon occurs so rapidly that the pilot cannot always be forewarned. To summarize the general requirements for forecasting hailstorms, and attendant thunderstorms, these points should be checked:

- *Amount of moisture aloft.* Although a sounding may show a great degree of instability, no clouds develop if the atmosphere is exceedingly dry. A moist layer shows 70 per cent or more relative humidity.

- *Height and Thickness of unstable layer.* Cumulus clouds form with instability below the freezing level. However, for cumulus to reach severe thunderstorm proportions, and to cause hail, the unstable layer should extend at least 15,000 feet above the cloud base.

- *Height Above Freezing Level.* Hail is more likely to form with a low freezing level in springtime conditions, since more of the unstable region is in temperatures below zero.

- *Amount of Thermal Heating.* In order for convective currents to begin, a certain amount of surface heating is required. This amount can be determined by estimating the dry adiabatic temperature at the convective condensation level, and the maximum surface temperature.

- *Local Forecasting Experience.* By studying the local records, valuable information can be obtained on the synoptic patterns and on the critical values of the upper-air elements that prevail during days when hailstorms occur.

We generally think of hail as going hand-in-hand with thunderstorms, but the geographical distribution of the two are not always the same. Scientists have discovered that the worldwide occurrence of hail seems to be most frequent in "continental interiors of middle latitudes." This occurrence diminishes seaward, toward the equator, and toward the poles.

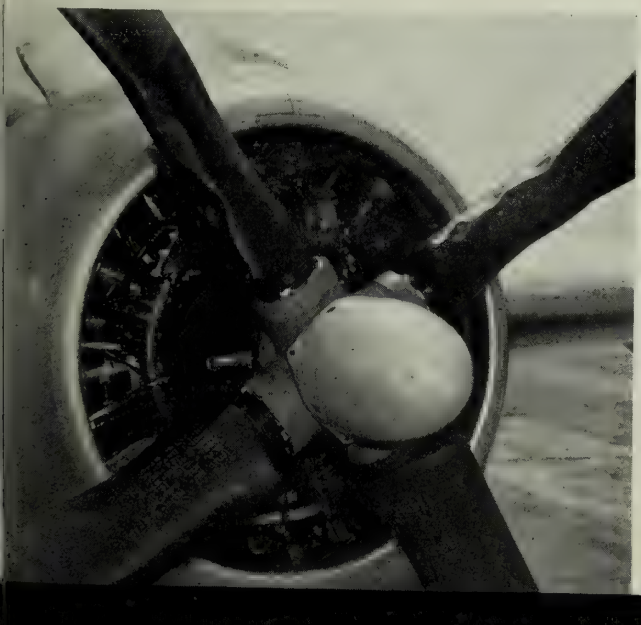
Meteorologists also agree that 50 per cent of all hailstorms occur between 1400 and 1600, Local Standard Time, and that less than 10 per cent of the hailstorms occur between midnight and noon. A study made some years ago by a large scheduled airline showed that in the Central and Eastern United States, hail usually falls in showers of dangerous size between 1200 and 2100 hours, Local Standard Time, and is especially frequent between 1500 and 1800 hours, Local Standard Time. A study recently completed in the Denver (Colo.) area, showed that in the month of May, the average time of occurrence was around 1300 hours, but that this time had shifted to 1430 hours by September.

In the United States, hail is generally a warm-season phenomenon. The country can be divided into three regions of hail-occurrence . . . East and South . . . Ohio Valley, Great Plains and Rocky Mountains . . . and the Pacific Coast area.

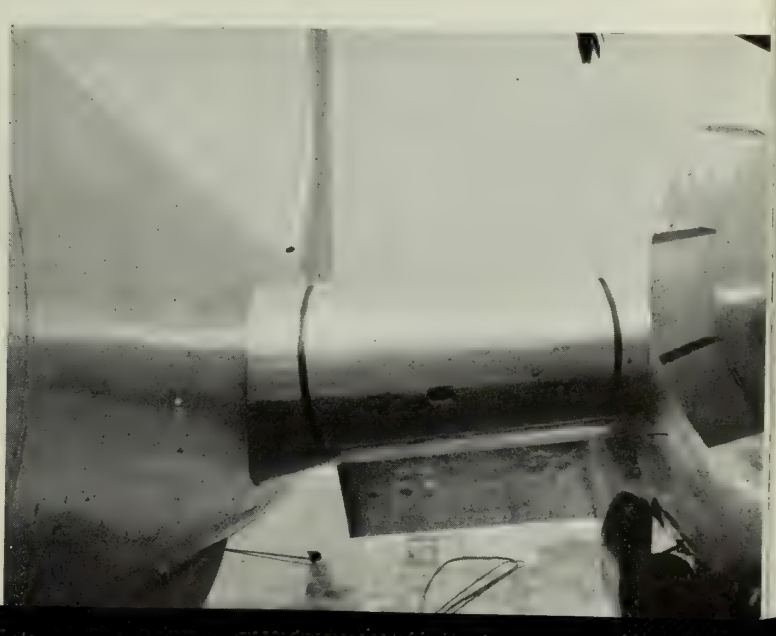
The general pattern of hail areas follows this trend. Early in January the light hail area starts in the South, and gradually spreads northward. Most of the East and South have some hail from mid-March to mid-June. A gradual waning of activity, especially in the coastal areas is then evident. In the interior, there is a warm-season northward development, with a noticeable spread of hail activity, beginning in February. By June this area has reached the plains and the Rocky Mountain country, and by late September, has started to recede southward with lessening intensity.

Reports by pilots indicate that hail is encountered most often over the Florida area at 16,000 feet MSL, and over Ohio at 10,000 feet MSL. However, seldom was hail found at more than one or two levels in the thunder-

**Prop blades on this B-29 took a beating from hail.**



**Light hail scored this B-50 wing edge, dented the flaps.**



storm. From this, it appears that hail occurs in very narrow bands within thunderstorm clouds, and occurs less frequently above 20,000 feet MSL. The average duration of a hailstorm is generally accepted to be fifteen minutes, although reports have been verified where hailstones have formed on the ground to a depth of two feet, denoting a longer period of fall.

### From Convective Clouds

Hailstones fall almost exclusively from convective clouds, although hail does not fall from all thunderstorms. The mechanics of the thunderstorm have been well established, and we will not go into these details in this article. Although we know how a thunderstorm is made up, the production of hail in a thunderstorm is still somewhat of a mystery to the metro man. We do know that in general, the more violent storms produce hail.

Studies have been conducted by various airline companies, meteorological agencies, and USAF Air Weather Service to determine the weather factors associated with hail. The thunderstorms associated with airplane hail encounters have been classified as (1) Cold front, (2) Warm front, and (3) Air mass.

Of 78 cases of hail encounter reported, 59 were attributed to cold-front action; 13 were caused by air mass activity alone, and six were caused by warm-front action. Therefore, it is obvious that cold front action will be the most likely to produce hail damage to your airplane.

East of Indiana the percentage of cold-front hail encounters was the most pronounced. Here, eight out of ten cases of hail encounters were from cold-front activity.

It was also found that the cold-front storms occurred most frequently between 1400 and 2200 LST, and reached a maximum at 1530 LST. Most of the air mass storms occurred between 1400 and 1500 hours LST.

### Radar Detection

A great many of our large USAF airplanes are now equipped with radar that can be used to detect areas of precipitation. By using this equipment, and by knowing how to interpret what is seen on the scope, the pilot can avoid danger areas. If it is impossible to circumnavigate these areas, the pilot can pick the safest route. During test flights using radar equipment, 32 hail encounters were analyzed. It was found that 31 of these cases occurred in heavy rain areas, and only one in light rain areas. Interpretation on the PPI scope showed that of the 31 hail encounters during heavy rain, 28 cases occurred during the first 15 seconds of heavy rain, following the light rain.

Here are the areas where hail-producing storms are found. These figures coincide with ground weather reports and with crop-hail damage insurance rates . . . and you can't beat the insurance companies along this line of knowledge.

You are most likely to encounter damaging hail between the Mississippi River and the Continental Divide. This area accounts for 74 per cent of all hail damage to aircraft. Sixty-four per cent of hail damage occurred during the months of April, May and June.

Of all hail damage analyzed, 56 per cent was encountered aloft between 1400 and 1600 hours LST, and 85 per cent occurred between 1400 and 2200 hours LST.

Pilot reports show that the average distance flown through hail was about five miles, although reports ranged from one to thirty miles. The common width of hailstorms, however, is one to two miles, although hailstorms 75 miles in width have been reported.

The best advice to pilots is not to fly through thunderstorms, *period.* However, there are times when this can't be avoided. That's why it's a good thing to know all about the mechanics of thunderstorms, and be prepared to carry on safely through wind, and storm, and sleet and hail—if you can't do it any other way! ●

**Large hailstones knocked deep dents in this spinner and battered the paint from the leading edges of the wings and cowlings in a violent thunderstorm.**

*Acknowledgment is given to Mr. Robert K. Souter and to Mr. Joseph B. Emerson, of the National Advisory Committee for Aeronautics, for the technical information derived from their study, "Summary of Hail Literature and the Effect of Hail on Aircraft in Flight."*

# the BREATH of life

**Breathing at altitude comes real easy with the new D-1 type oxygen regulator—**

THE NOMENCLATURE for certain items of military equipment is always good for a chuckle or two. The official name of the D-1 oxygen regulator is likewise amusing, but improper functioning of the device could prove to be extremely unfunny.

The Tech Order describes the regulator as an "Automatic Positive Pressure Diluter Demand Oxygen Regulator," which is an important sounding name for a very important piece of machinery.

With the automix lever set at "Normal Oxygen," the regulator will deliver a mixture of air and oxygen in the quantity demanded by inhalation at the mask. The ratio of air to oxygen varies with the altitude and is automatically regulated. As an airplane's altitude is increased, the quantity of air mixed with the oxygen is decreased until, at a cabin altitude of approximately 32,000 feet, pure oxygen is delivered to the mask.

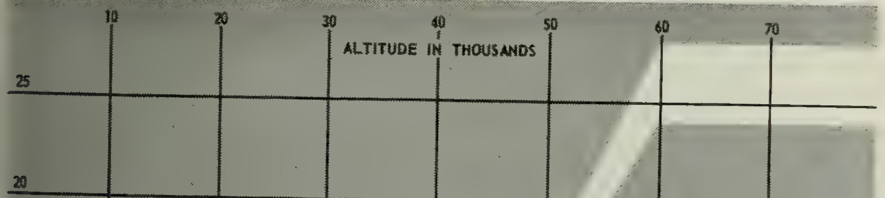
Speaking of masks, there is only one type which should be used with the D-1, and the later model D-2—and that's the A-13A pressure demand mask. Many complaints of regulator malfunction have been traced to usage of the wrong mask.

By placing the automix lever on "100 per cent Oxygen," the regulator will deliver undiluted oxygen in the quantity demanded by inhalation at the mask. This handy little switch should be used whenever a pilot detects noxious fumes or gases in the cockpit. In addition, it's a good idea to have 100 per cent oxygen turned on for all taxi operations.

Upon reaching an altitude of approximately 39,000 feet, an aneroid mechanism in the back of the regulator automatically causes the internal regulator pressure to rise, thus causing a higher pressure to be delivered to the mask, compensating for any small leakage.

The regulator incorporates a built-in warning system used in conjunction with a warning light at the regulator station and a warning light at a central control panel. With the warning switch in the "ON" position, the lights will be dim under normal operating conditions. However, under conditions of zero flow or steady flow, the light will become bright, indicating a pause in the breathing cycle.

Note the difference in operating altitudes of the D-1 and D-2 Oxygen Regulators.



The warning light will shine brightly for the following reasons:

- Leaking hose.
- Leaking or accidental parting of the quick disconnect.
- Wrong type mask.
- Oxygen supply depleted.
- Mask valve blockage.
- Regulator failure.

If the warning lights fail to work at all, any one of three things may be responsible:

- Switch off.
- Bulb burned out.
- Electrical failure.

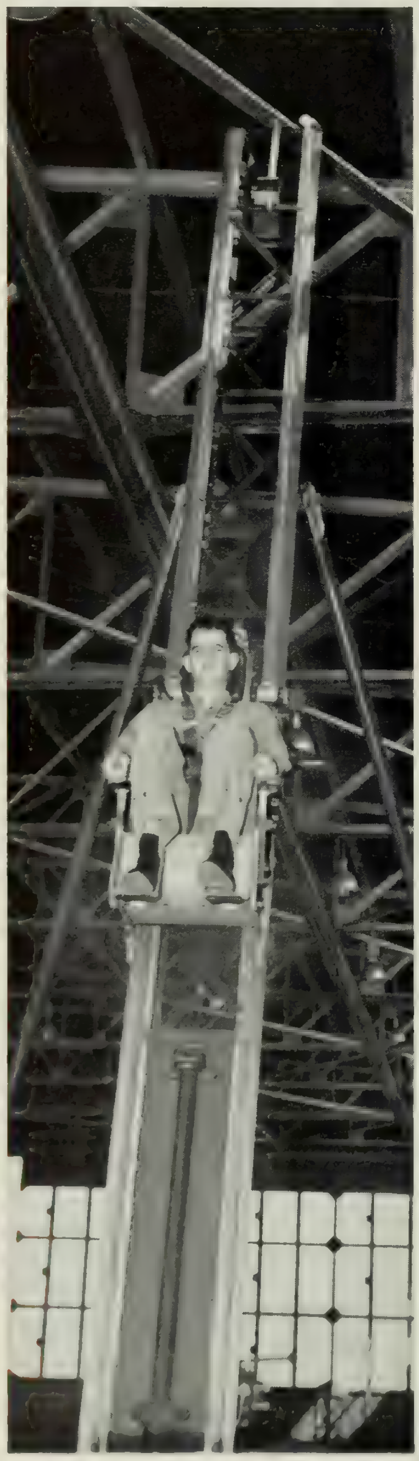
There's an important thing to remember about the regulator . . . if you're flying at extreme altitude and you get in trouble which you can't diagnose, use your bailout bottle immediately. Then, with the bailout bottle providing your oxygen, start your descent and get down to a safe altitude. There, you can do a more thorough job of experimenting.

Research specialists at the WADC Aero-Medical Lab have developed a new model of the oxygen regulator, known as the D-2. Physically, in design, it is similar to the D-1.

However, where the D-1 starts metering pressure automatically at 12,000 feet, the D-2 does not perform this function until 30,000. Then, the D-2 evidences a marked superiority. While the D-1 will not sustain consciousness above 50,000 feet, the new D-2 will sustain life at altitudes up to 80,000 feet, provided the proper counter pressurization exists.

The D-2 is soon to be used in conjunction with the T-1 High Altitude suit, which will supply counter pressure over most of the body. ●

The ejection trainer operates out of a cockpit mockup and the seat is propelled from nine to 16 feet up the track.



# Ridin' the rails —

WITH the development of aircraft capable of speed in excess of 300 MPH, successful escape by simple bailout has become increasingly hazardous, if not impossible.

The engineer's anwer to this problem resulted in the development of the ejection seat. This device in turn introduced a need for reassurance of aircrew personnel that the ejection seat was not in itself a great hazard, and that proficiency in its use would provide successful escape. To provide such assurance, practice ejection during actual flight was impractical; therefore some other means of indoctrination and training became a primary necessity.

Two large ejection seat towers, one at Williams Air Force Base, the other at Wright-Patterson AFB, have been used for study and demonstration of the forces developed during ejection, but do not realistically simulate all conditions and procedures found in aircraft. In order to remedy this objection and to provide training conditions and procedures closely simulating those found in operational aircraft, a portable unit incorporating a cockpit mockup and a fighter seat has been built by All American Airways of Wilmington, Delaware. This portable device permits more effective practice in the procedures required for successful firing and ejection.

Twelve of these portable trainers were acquired and modified by having the face curtain removed from the seat, arm rests and an Air Force catapult installed. The trainers are in the process of assignment in the field.

### Trainers Tested

Preliminary to placing trainers in the field, the Surgeon General of the Air Force arranged for Frankfort Arsenal to carry out exhaustive tests in the modification of the catapult and cartridge to assure safe and efficient operation. The first of the units was delivered to the School of Aviation Medicine, Gunter AFB, on 18 December 1952 and has been in operation since 20 January 1953.

The portable trainer consists of a substantial base of steel beams to which the cockpit mockup and a track bearing tower are attached. The overall height of the assembled trainer is 25 feet and requires an area of 30 feet x 30 feet for operation. With the tower collapsed and supporting base pulled together, it has a length of 29 feet, a width of 8 feet and a height of 5 feet. Total weight of the assembled trainer is about 4,000 pounds. The base rests on five wheels, three of which are swivel mounted to permit movement. Screw jacks adjacent to each wheel provide a means for immobilizing and stabilizing the trainer during operation.

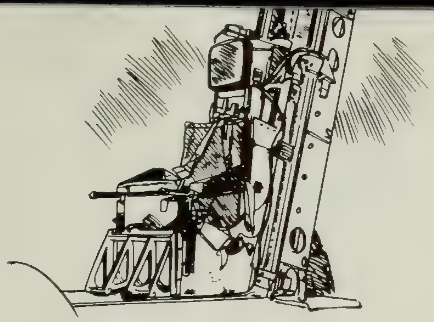
The T-14-E-1 Catapult used by the Air Force trainer is a two-tubed telescope unit with removable firing head, trunnions for seat attachment, base mounting and a locking mechanism. The brass cartridge has the casing of a 60 caliber shell and provides a maximum acceleration of 10 G's at the rate of 150 G's per second.

The propellant charge carries the seat from 9 feet to 16 feet up the 20-foot track. An upper buffer near the top of the tower has friction brake shoes to decelerate the seat if it should travel the full length of the track. After reaching the peak of its travel, it descends under control of an automatic brake device. A hydraulic system stops the seat in a pre-loading position on descent, and a hand valve permits lowering of the seat into the cockpit for firing position.

### Instructor's Panel

There is an instructor's panel mounted on the forward end of the cockpit. It is so wired that a series of actions are required preliminary to firing the seat. These actions are indicated by lights on the panel. The lights record proper throttle position, activation of the bailout oxygen cylinder, feet placement in the stirrups, and elevation of the left and right

# The new "seat with a send-off" will boost you up and let you down—easy.



arm rests. Various types and models of aircraft will depart from the procedures as wired in the trainer but alteration may be made to simulate the desired sequence for ejection.

For example, the canopy release may be a separate release lever in some aircraft and as such may be wired into the panel for indoctrination. The sides of the cockpit are hinged and wired to a buzzer which is activated when the arms or any part of the body strikes the sides during ejection. The forward fixed position of cockpit (wind screen) is simulated by aluminum tubing which is displaced if feet strike it during ejection.

The instructor has remote control of the firing pin assembly so that the seat cannot be fired by the trainee until the instructor activates the solenoid which releases the safety of the firing pin. As a safety factor in the trainer, this circuit cannot be completed unless the safety belt is buckled. The lap belt should be unfastened in aircraft prior to ejection at low altitude. The oxygen bailout cylinder need not be used at altitudes below 20,000 feet.

**After reaching the peak of its travel up the track, the seat is then decelerated and descends automatically to a pre-load position.**

An added safety factor was provided by Frankfort Arsenal for the Air Force Trainer by introduction of a cable and lever device to lock the catapult tubes together so that in case of misfire or other malfunction the trainee may safely leave the seat. Locking the catapult tubes prevents the tubes of the catapult from separating and should the shell explode under these conditions, the pressure from the bases is slowly lost without ejection of the seat.

### Trainee Indoctrination

Indoctrination of Air Force personnel in the use of the ejection seat includes a discussion of the problems of escape and a showing of the training film (TFI-4680) which demonstrates conditions and procedures preliminary to and during ejection. The trainees are then taken to the trainer where they are instructed in the proper position and sequence of the various actions required in aircraft and the trainer to eject successfully. The trainee then fires himself after satisfying the instructor that he can rapidly and efficiently accomplish the pre-firing actions in proper sequence.

*Before* the trainee is in a position simulating that of a pilot actually operating an aircraft the following sequence is performed:

- The trainee enters the seat in a pre-load position. The catapult is armed but a banana pin is left in place, locking the safety that is released by the solenoid.
- The seat belt and shoulder harness are fastened to complete a circuit permitting later release of the firing pin by the instructor.
- The seat is lowered into pre-ejection position in the cockpit by releasing the hydraulic brake and guiding the inner tube of the catapult into the outer shell.
- The banana pin is removed to permit the instructor to operate the solenoid release of the firing pin when the trainee has completed all the pre-fire steps.

*After* the trainee is lowered into the proper pre-ejection position in the cockpit, he proceeds to take the following actions which are indicated on the instructor's panel:

- Throttle retarded.
- Oxygen cylinder activated.
- Left arm rest raised.
- Right arm rest raised.
- Feet properly placed in stirrups, head back against head rest, chin in, back straight against seat. (Instructor releases solenoid to permit firing.)
- Squeeze the trigger on the right arm rest until catapult is fired.

• • •

After reaching the peak of its flight up the track, the seat automatically descends slowly to a pre-load position. Subjectively, the sensations are the same as those from a heavier charge in the larger tower or actual ejection from operational aircraft, and the trainee should have acquired a knowledge of procedures and an assurance that the seat will provide an escape at high speeds and high G accelerations without injury. ●

Gunnery techniques have changed since the days pilots exchanged pistol shots in passing. Today, high speeds call for more emphasis on safety.

# . . . it take

THOSE who were there claim that aerial gunnery started one day during the first big hassle when an irate Frenchman splashed a German counterpart with a load of Old Dad's Special Number 7 chilled birdshot. The Boche being somewhat annoyed by such unorthodox behavior, responded by emptying his Luger clip after the retreating Frenchman, and the fight was on.

In those pioneering days safety consisted mainly of staying in the animated box kite after blasting off both barrels of the old twelve gauge. Later, when they got around to using a Lewis, the main safety problem was to keep from shooting off your own prop during a dogfight.

As gunnery techniques advanced and aerial and ground practice gunnery ranges were developed, the need for more emphasis on safety became apparent. It was one thing to close on a target at 100 knots or so and quite another as speeds were upped.

In today's aircraft, which are infinitely more complex and employ complicated gunsights, a pilot approaches his target at high speeds. At best he has but a few seconds to sight, fire and pull off before he is right on top of the target. If a pilot waits too long, flies an improper pattern or tries to stretch the regs and SOPs

# TWO to tangle!

set forth for gunnery runs, the chances are that he will be involved in a major accident before he knows what is happening. The lucky ones inflict major damage to the aircraft; those less lucky end up as statistics.

### 100 Major Accidents

In 1952, over 100 major accidents occurred during gunnery practice. Most of the accidents involved collision with either a tow target, a ground target or occurred when the aircraft was flown into the ground after firing; although a few involved collision between two aircraft.

Naturally every pilot wants to get a high score when firing gunnery but when he breaks the rules to do it he is only inviting disaster while cheating himself. Typical examples of these needless accidents show that in every case pilot error was the primary reason they happened.

A typical head-up stunt was pulled by the pilot of an F-86. On his first firing run at a tow target he flew directly into the sun and was blinded. Instead of obeying his unit SOP which stated that a firing pass will be aborted when the pilot is blinded, and completely ignoring the dictates of common sense, this pipe jockey bored right on in. Needless to say, he rammed the target. He broke off only after he had embedded the tow bar firmly in his right wing.

Explaining the accident later, he admitted, "I lost the target in the sun after starting the pass but figured I would be able to see it when I got close in. I never did find it again and didn't know I was close till I felt the aircraft hit something. I lost control after the collision but after a few rolls I straightened it out and got it down." This lad was walking with the angels and didn't know it.

An F-84 received major damage when an over-eager pilot pounded into the target, tearing up the wing and ripping off the tiptank. The pilot violated his squadron SOP by holding his fire until he was below minimum firing distance of 600 feet.

Competition in the outfit for high score was keen and this joker decided he would really raise his hit total by getting on top of the target before firing. He did; in fact he got so close that when he tried to break away he scored a direct hit he hadn't planned upon, only this one was made with his plane. As a result of his effort to win the competition the accident board recommended that "the Squadron Commander be cautioned to observe carefully the extent of the competition among pilots firing aerial gunnery and temper such competition when it may interfere with safety."

In another accident involving an F-86 the pilot hit the tow bar and cable while making a low angle firing pass. The pilot disregarded the briefing he received before the flight and started firing from an in trail position, out of a long, flat pass.

He opened fire at 250 feet and while he didn't shoot the target off before colliding with it he did manage to scare the pants off the tow pilot. His poor technique and disregard for briefing instructions resulted in major damage to the plane and almost in the loss of another.

A third F-86 pilot wasn't so lucky. On a ground gunnery mission he flew his aircraft into the ground 1,000 feet beyond the target. On several of his five previous passes he had trouble lining up on the target and had refrained from firing. On the sixth and last scheduled pass the aircraft came in at between a 30 to 35-degree angle, dive brakes weren't used for recovery and no attempt was made to pull out till well below minimum altitude. Investigators concluded that the pilot badly misjudged his distance above the ground, probably due to over-eagerness to expend all the remaining rounds of ammunition. Another case where a stretched regulation ended up tragically.

### Misjudged Altitude

An F-51 jockey was more fortunate after trying for a high score by pressing his attack in too close to the target. He stated that he was very anxious to get a high score and misjudged his altitude, starting the pull up too late. He slammed into the top of the ground target but was able to keep the aircraft flying and got home, with a badly damaged plane.

Another F-51 also figured in an unusual target collision accident. The pilot had made several passes and evidently had frayed the cable on one pass. He then made an extremely poor pattern and ended up flying straight and level behind the target and tow ship. Instead of breaking off as briefed to do on poor passes, he closed in on the target. However, before he could fire the cable parted and the target hit his plane. The major damage to his aircraft would have been averted if he had followed his squadron SOP, written for his safety.

In a similar accident another F-51 was badly damaged when it collided with a shot off target. The pilot went in too close, shot off the target and

**Principal cause factors in aerial gunnery accidents are poor gunnery pattern techniques and failure to obey gunnery SOPs and regulations.**

then decided to break down and away instead of up. As he started his break the tow cable parted and the target fell down and away, proving the old adage that two objects can't occupy the same space at the same time.

### In-Trail Position

Another jet boy who conclusively demonstrated that he had his mind elsewhere than on his business was the F-80 driver who hit a target while in an in-trail position.

He stated, "I *guess* I made a poor pass because I ended up directly in trail with the target. I lost sight of it but thought when I closed in I would be able to see it again." Unfortunately for himself and his aircraft he didn't until he was too close to avoid hitting it. Accident causes were listed as poor planning, poor judgment displayed by the pilot in not aborting the pass after losing sight of the target, and misjudging his distance and angle of attack.

An expensive accident to another F-80 came about in the same way when the pilot decided to fire up the tail pipe of the tow ship.

He also got in trail with the target but claimed that he could see it all the way. Despite this, he fired when directly behind and within 200 feet of the target. He continued on until hitting it, lost control of his aircraft and narrowly averted crashing before regaining control.

Several accidents were caused by a pilot taking his eyes off the target at the last moment, usually by putting his head in the cockpit.

In one, the pilot of an F-51 made a sighter pass and then proceeded to make a firing run. After entering into the pass he looked into the cockpit to change the gunsight switch. Seemingly, he found something sufficiently diverting to hold his attention until he felt a hard jolt. The jolt turned out to be the tow target. He managed to add a few gray hairs to the tow pilot's thatch as he was unable to regain control and break off until he had barely missed the tow plane.

### Sweating It Out

An F-94 pilot found it necessary to sweat one out the hard way when his vision was obscured by sweat running down into his eyes. He had been having touble getting positioned and had been making all his passes too close and at too low an angle. The tow pilot warned him several times about getting in so close at an improper angle.

Finally, he decided to stabilize the gunsight by depressurizing the cockpit at an altitude of 12,000 feet. It soon became very warm and he started to sweat profusely. The perspiration ran into his eyes and while in his next pass he used his right arm to wipe his eyes while flying with his left hand. He had trouble clearing his vision and lost sight of the target but made no attempt to break away. While still trying to regain full sight he hit the target and cable, which became embedded in the wing.

Another head-in-the-cockpit deal ended when an F-86 crashed while on a ground gunnery mission. The pilot made two dry runs, claiming he was having trouble holding his sight on the target. On his third run, he called again and said he would readjust the sight and make it a dry run. Instead, he started firing when very close to the ground and flew the aircraft so low that recovery was impossible. Investigators concluded that he had become preoccupied with the sight and didn't realize his altitude.

Occasionally, supervisory personnel contribute to these accidents by not enforcing regulations or by allowing inexperienced pilots to fly gunnery before they are ready.

A case in point occurred when a relatively inexperienced pilot received a brief checkout in an F-84 and then was sent on a strafing mission.

During the checkout period his instructors noted that he was a slow student and seemed unsure of himself in certain phases of the training. Despite this, he was scheduled for ground gunnery training.

During his first strafing mission he was repeatedly warned to adjust his pattern as he was far too low and slow on his base leg and when turning onto the final.

Finally, he made an especially low turn at an obviously low airspeed and flew the aircraft into the ground several thousand feet short of the target. Observers stated that he had evidently put his head down in the cockpit and didn't look up until it was too late to effect recovery, as the aircraft came in at a steep angle, with no attempt made to pull up until just prior to hitting the ground.

Supervisory personnel and flight leaders also come in for a share of the blame on these accidents. The findings of a study of ground and aerial collisions made by the Directorate of Flight Safety Research, showed that published procedures for aerial gunnery and simulated fighter attacks are not being enforced by flight leaders and supervisory personnel. The study recommended that these procedures and simulated attacks be reviewed for safety by commanders and that supervisors and flight leaders be required to thoroughly brief pilots for these missions.

**If the day ever arrives when you have to bail out of a Bravo 25, you had better . . .**

# *know* BEFORE *you* GO!..

THE SUBJECT OF PROPER bailout procedures in B-25 airplanes has arisen on numerous occasions, all of which have not been exactly auspicious. The Bravo-Two-Five, in addition to being used as a trainer, is doing yeoman service in many commands as a transport. To say that most B-25's are getting a bit long in the tooth is somewhat less than an understatement, and there have been times when passengers in this usually reliable beastie have looked frantically for an exit from which to drop into the vastness below.

Even pilots who should know better have suggested under duress of emergency, that they were "just about ready to go out through the top hatch." The plight of the passenger, who more often than not—is a nonrated type, can be appreciated. In the absence of an alarm bell, when the crewchief worms his way through the tunnel and suggests leaving the machine for greener pastures, the passenger is likely to stagger around the aft section like the proverbial blind dog in a meat house, hunting a way out. Even when he finds it, he doesn't know what to do with it.

This lucid presentation of the problem at hand, is primarly directed to he *passengaire*. Pilots will do well o spell out the longer words, because rom the ample quarters of the flight leck, it is awful easy to panic out hrough the roof. The result of this ct is a sharp blow across the *derriere*, inflicted by the rudder section, which renders an otherwise safe parachute landing null and void.

In leafing through the compendium of the Dash-One on the B-25, we come o Section III, "Emergency Operaion." On the first page is a large lrawing. The arrow points right lown to the top hatch, and the "baloon" says, "*Do not, under any cirumstances, use the pilot's escape atch for emergency exit in flight.*" This hatch is used primarily for rawling out of, red faced, after you ave landed with the gear retracted.

As anyone should know, there are nly two holes for in-flight bailout, the front hatch and the rear hatch, both located on the floor of the machine. The front hatch has an inner door, accordion hinged, and on many administrative models, the rear hatch also has an inner door. These doors must, of course, be raised before the escape hatches can be jettisoned for bailout purposes. Therefore it is not good practice to stow luggage atop this inner door. It only adds to the confusion.

When the decision to abandon the airplane has been made, the pilot, if possible, reduces the airspeed to 170 miles per hour. He trims it slightly nose down, and points the nose for an open, uninhabited, and preferably flat, area of the countryside.

At this point, we digress slightly. Ordinarily, there is an alarm bell system installed in the B-25. It should be tested during the preflight check, and explained to the passengers. The bailout signal is three short rings for the stand-by, and one long ring for the actual jump. However, as an added safety factor, it is imperative that at all times during flight, one passenger in the aft section keep the earphones on his head, and listen for instructions via the interphone.

Another safety point. If the aircraft is in such distress that the hydraulic pressure is lost, those bomb bay doors are going to drop open as far as two-thirds full travel. If you still have hydraulic pressure, make sure that the bomb bay doors are closed before you try to bail out from the forward hatch. If the doors won't stay closed, drop them full open, as the danger of striking them is lessened if they are down full travel. We can say without contradiction that striking the edge of a bomb bay door at 170 MPH is similar to falling on a picket fence.

Bailing out from the forward hatch takes a little clear thinking, and some prior planning. First you open the inner door. Do this before you jettison the hatch, as a vacuum may be set up which could keep the inner door from being lifted.

**In some B-25 administrative aircraft seats forward and aft of the rear hatch preclude an SOP for bailout.**

The next step is to stand at the forward edge of the hatch, facing the rear of the airplane. Crouch down, and put your hands on the rear edge of the hatch. Roll out head first through the hatch, using your hands and arms to protect your face. All this after pulling your parachute leg straps good and snug. (We have assumed, of course, that you wear your parachutes at all times in a B-25.)

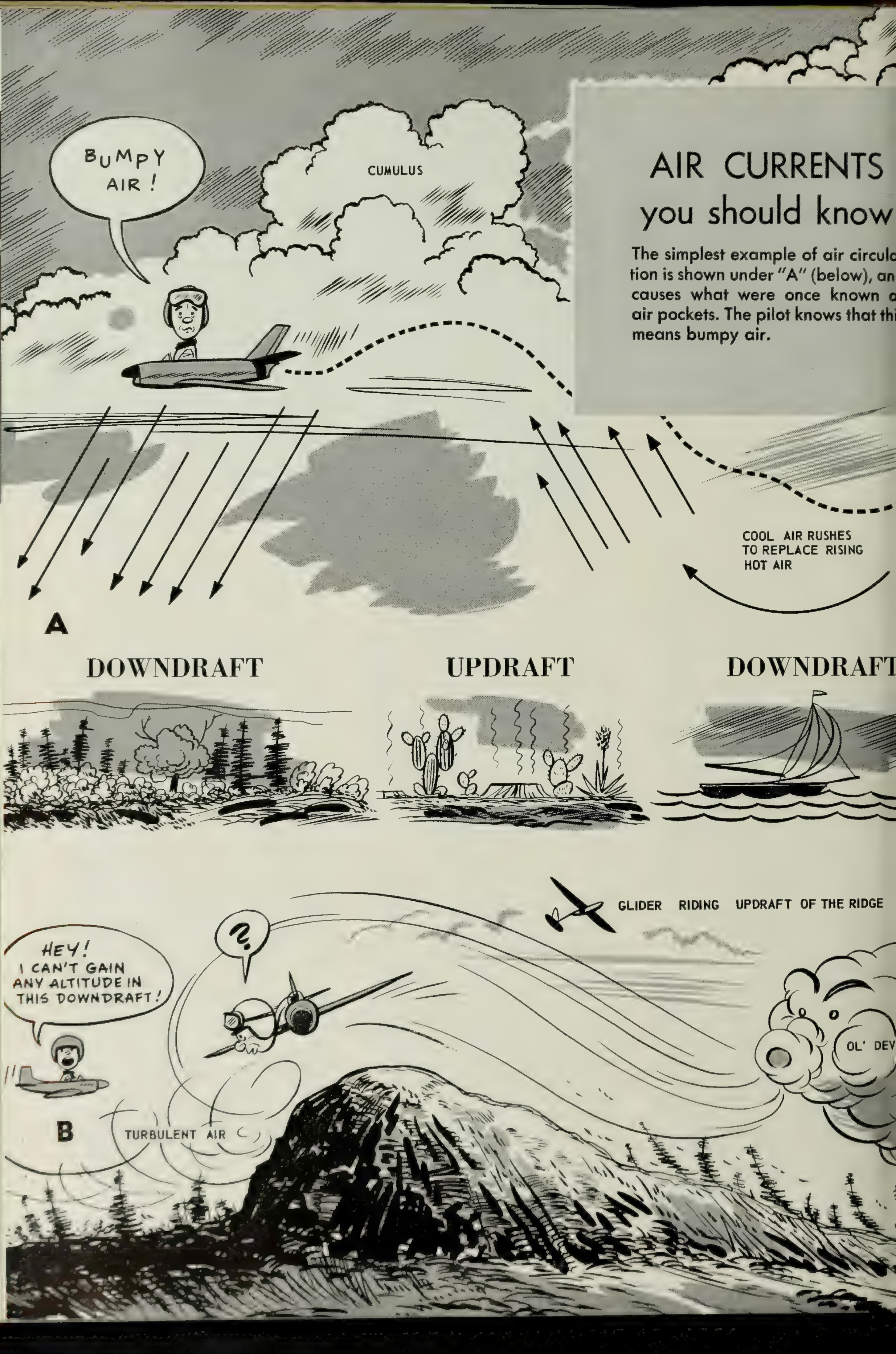
In bailing out from the rear hatch position, a slightly different procedure is recommended. After opening the upper door, and jettisoning the hatch, squat down at the rear edge of the hatch, grasping the edge of the hatch with your hands, and facing the front of the airplane. Using your hands as a pivot, roll through the hatch head first, and drop through, keeping your head tucked well down on your chest, and your hands clasped under your knees. Freefall for at least three seconds before you pull the D-ring. Best way to do this is to count, "one thousand one; one thousand two; one thousand three," and then pull the ripcord.

Knowing your way out of an airplane, coupled with proper chute adjustment, and an understanding of how to strike the ground will preclude injuries, and result in an easy landing, only slightly harder than jumping off Mom's icebox or the woodshed roof.

Thousands of soldiers have jumped out of airplanes with nary a scratch, so there's no reason why you can't do the same . . . PROVIDED you know what you're doing, and keep clear of the panic button. ●

# AIR CURRENTS you should know

The simplest example of air circulation is shown under "A" (below), an causes what were once known a air pockets. The pilot knows that thi means bumpy air.

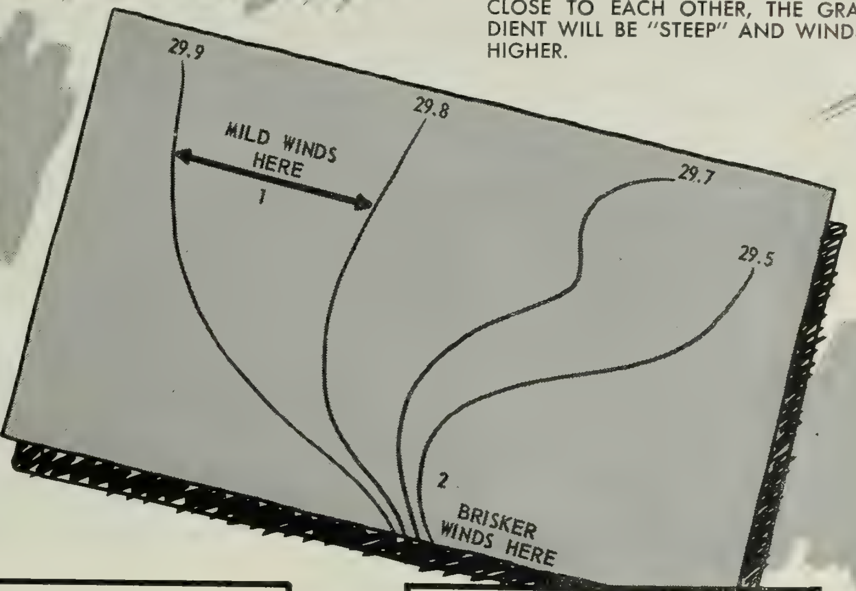

BUMPY AIR!
CUMULUS
COOL AIR RUSHES TO REPLACE RISING HOT AIR
A
DOWNDRAFT
UPDRAFT
DOWNDRAFT
GLIDER RIDING UPDRAFT OF THE RIDGE
HEY! I CAN'T GAIN ANY ALTITUDE IN THIS DOWNDRAFT!
?
OL' DEV
B
TURBULENT AIR

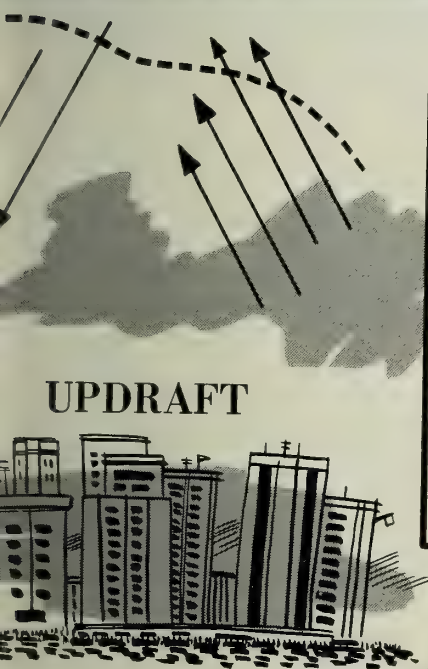
Moving air will follow the contour of the land over which it flows. Vhen air flows over a mountain it nakes a turbulent waterfall effect on the lee side. Note "B".

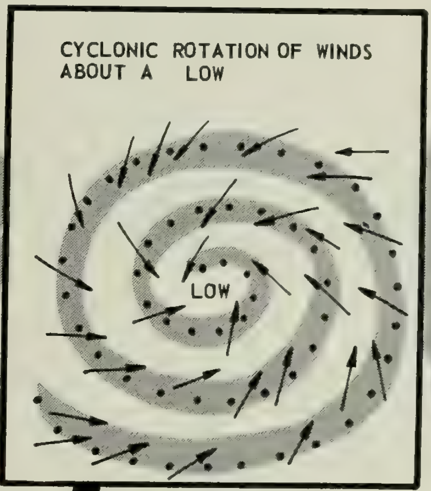
he disturbance between high and ow pressure areas always results in parometric argument, and the high sually wins (Note "C").

1 SHALLOW GRADIENTS SHOW MILD WINDS.

2. IF WEATHER MAP'S ISOBARS ARE CLOSE TO EACH OTHER, THE GRADIENT WILL BE "STEEP" AND WINDS HIGHER.

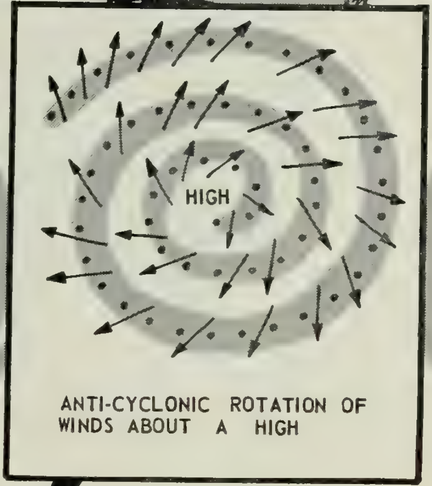






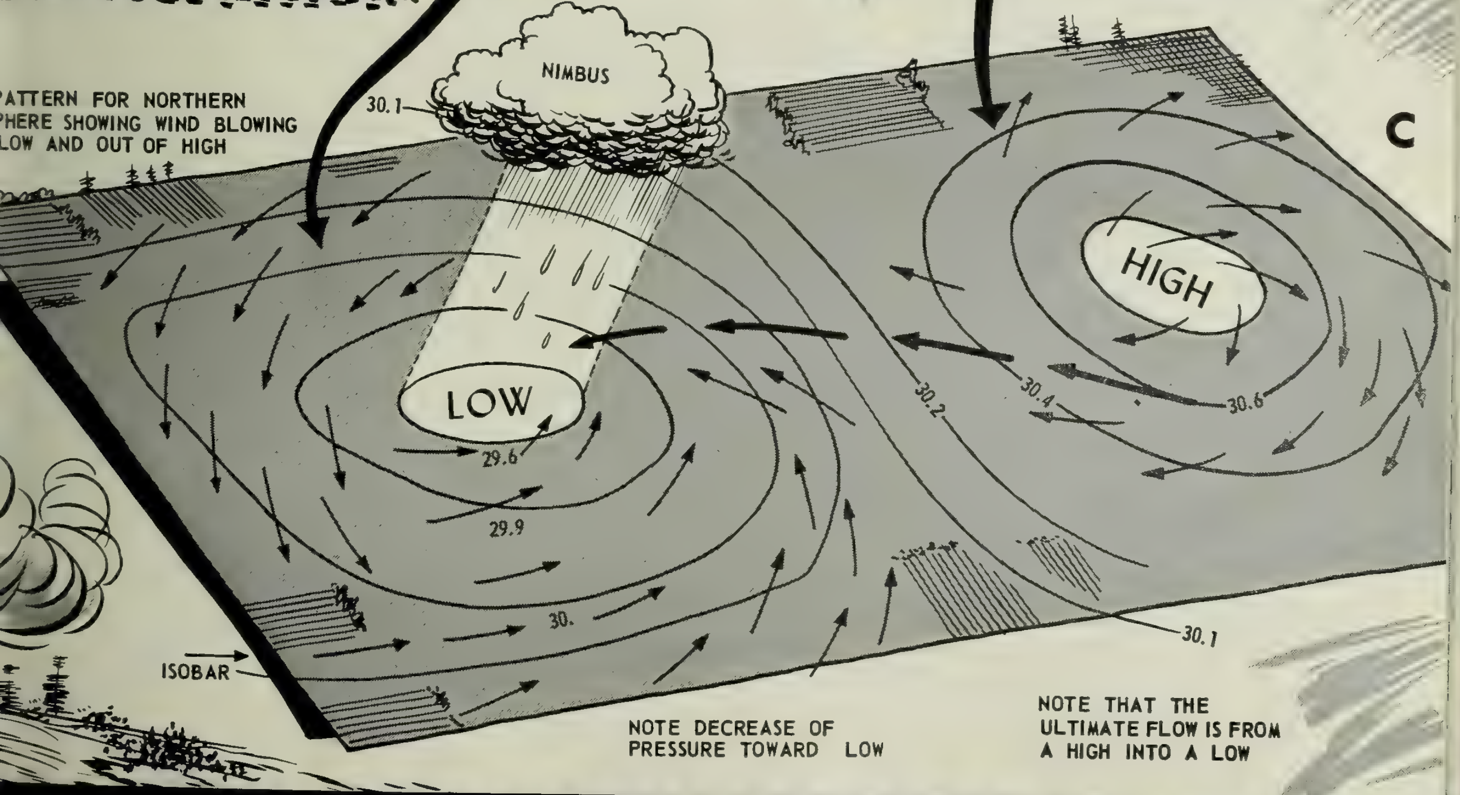
CYCLONIC ROTATION OF WINDS ABOUT A LOW

NOTE: WIND IS INWARD AND ANTI-CLOCKWISE.



ANTI-CYCLONIC ROTATION OF WINDS ABOUT A HIGH

NOTE: WIND IS OUTWARD AND CLOCKWISE.



ATTERN FOR NORTHERN HERE SHOWING WIND BLOWING LOW AND OUT OF HIGH

NOTE DECREASE OF PRESSURE TOWARD LOW

NOTE THAT THE ULTIMATE FLOW IS FROM A HIGH INTO A LOW

The giant eight-jet YB-52 is undergoing additional test programs.

# SHAPES IN THE SKY OF TOMORROW

By Flight Lt. D. G. Bailey, RAF Travis Air Force Base, Calif.

IT was plainly obvious at the conclusion of World War II that for several years at least the heavy type aircraft of the United States Air Force and Royal Air Force squadrons would be of the type that saw front line service from the early 1940's.

The USAF had its trusty B-29, the RAF its Lancaster; but these types were not in themselves sufficient for the requirement of the postwar years and the need for aircraft capable of superior performance was met by several products of interim design.

The American B-50's and the British Lincolns, themselves derivatives of the war-time designs, took their places in the front line squadrons and an old American design concept, the B-36, was once again sought out from the designer's cupboard to become a most successful, very heavy, atomic bomber which may well, on its own, have been a reason for deterring the potential aggressor.

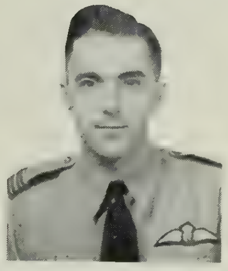
So much for the past, now what is to be looked for in the future? New design features have matured into realities and old, hazy mutterings of Mach numbers, compressibility, sweepback, razor thin wings, delta and crescent form wing shapes are now practical facts which should be understood and appreciated by all service pilots who possess aspirations for positions as commanders in later years, and who are destined to partake in the sub and supersonic phase of air power development.

It is both interesting and thought-provoking to study the trend so far in the design features of the heavier type aircraft of the United States Air Force and the Royal Air Force. Both services are receiving, or will receive, aircraft of basically different design. The American designers clearly favor the razor thin, swept-back wing with the jet engines slung under the wing in streamlined pods, whereas the British counterpart favors the faired-in power plant. The American design is proving to be sound and from a maintenance point of view, the "pod" is a very accessible housing for the jet engines.

Mounting the engines in this fashion makes it possible to construct a very thin wing, although this calls for a new home for the under-carriage. Boeing has found the answer by placing the main under-carriage in the fuselage with light, stabilizing wheels outboard where the structural penalty is least.

But why the striving for the thin wing? Because a thin wing combined with sweepback delays the compressibility effect at high Mach numbers and thus makes it possible to achieve a much higher critical Mach number. A disadvantage of the swept-back wing is that stalling occurs at the wing tip sometime before the rest of the wing which makes control difficult at low speeds such as when coming in to land. Furthermore, straight

**Above, the XF-92A goes over the top on a test flight.**



Flight Lieutenant D. G. Bailey, of the Royal Air Force, is currently assigned under the exchange training program with the United States Air Force. Attached to the 72nd Strategic Reconnaissance Squadron at Travis Air Force Base.

swept-back wings of high aspect ratio, i.e., ratio of span to chord, have certain twisting tendencies. Movement of the ailerons may tend to twist the wing so that the change of lift opposes the control force due to aileron movement and thus reduces control.

The characteristic clean British line which may be found in the newer four-jet bombers such as the Valiant, the Vulcan and the Victor is not without its penalties. A buried engine causes complication and inaccessibility for the maintenance crews, notwithstanding the difficulties of wing construction in relation to bending and torsion. It may well occur that he engine type may have to be changed even before the aircraft is ompleted and it is easy to imagine he design complications which might arise whilst modifying air intakes, or changing engine position to obtain hat final, acceptable center of gravty. The Valiant is an almost conventional looking aircraft, whereas the Vulcan employs the delta wing shape which looks quite odd as applied to an aircraft the size of the B-29.

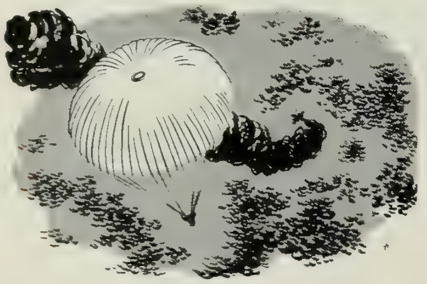
Perhaps the most interesting shape of all is to be found in the new Brit-sh Handley Page 80 bomber aircraft which has now been officially named he "Victor." This aircraft has a rescent form wing design and first lew as recently as last December 1952). The crescent form wing alows ample space for fuel tanks, unler-carriage, et cetera, in a light, fficient structure with parasite drag ept to an absolute minimum. The ngle of sweep back progressively decreases towards the tip, thus permitting the use of high aspect ratio for altitude performance with good behavior at the stall. The absence of the tendency for the wingtips to stall before the rest of the wing naturally gives docility in handling at low speeds. There is much less twisting tendency due to aileron control movement with the crescent wing owing to the reduced sweep back at the wing tips. The large center wing section provided by the crescent wing allows the main load bearing structure to be placed well forward, with the undercarriage and engines tucked in behind. With the main structure ahead of the fire zone the risk of an engine fire proving disastrous is remote.

It will be seen from the picture of the Victor that the flaps are affixed to the leading edge of the wing and that the inboard pair appear to deflect farther down than the outboard pair. Leading edge flaps, it would seem, have an unstable hinge movement—i.e., when deflected up or down they would tend to move to the full limit of their travel. Very powerful, long arm jacks would have to be employed to achieve adequate control over the control surface movement. Leading edge flaps when deflected down increase the camber of the wing at high angles of attack—such as at low speed—and thus afford an increase in lift. When deflected up the leading edge flap would still result in an increase in lift but would also incur a considerable increase in drag, the overall gain being slight. At supersonic speeds the leading edge flap would be much more effective than the conventional flap because the conventional flap normally obtains an increase in lift by raising the pressure beneath the wing; and at supersonic speeds the air under the wing would not be aware of the flap position, whereas the leading edge flap would obtain its function by altering the pressure and flow of the air behind the flap surface. Whether this supersonic advantage would apply to the new Victor, I do not feel disposed to conjecture. . . . It may be that this new crescent wing bomber will fly at very high *sub* sonic speeds in order to force attacking aircraft to fly through the sonic barrier hazard in order to obtain enough speed to enable them to position for attack.

Of one thing we may feel sure. Whatever the wing plan—may it be delta, swept-back with high aspect ratio or crescent form—the aircraft will be basically the same to handle as the "has beens" of today. Sub and supersonic aircraft must be easy enough to fly so that the normal, average and well trained service pilot can "tailor his touch" to the new type after a short period of transition training. In operating such aircraft the younger service pilots may well find that they have responsibilities far more heavy to shoulder than their counterparts of yesterday, and their decisions will have to be right the first time, as the margin of error will be very small. Surely, it is in their interest to study, think and discuss tomorrow's air—before the dawn has time to illuminate it. ●

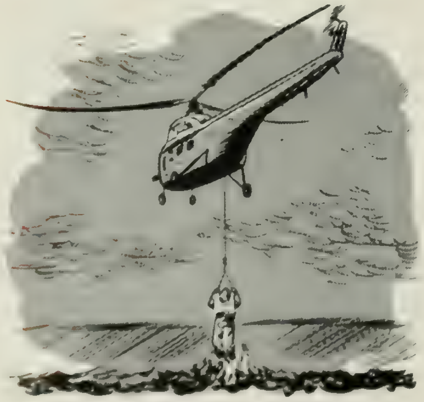
# SUIT FOR SURVIVAL

**Don't wait till you hit the drink to try this suit for size—you can get awfully wet in a hurry.**



. . . Out of the plane

. . . Into the water.



. . . Into the "bird."

"MAN, dig them crazy coveralls!"

This might be a bopster's approach to the M-4 anti-exposure suit, but you, my friend, had better start digging the instructions on the correct way to fit and wear this drape shape before you become swayed and greyed!

This contraption, known to the trade as Suit, Flying, Anti-exposure, M-4, consists of an insulating liner, or sort of long-drawers effect (sans drop-seat), and an outer covering of watertight material. In this chic number, the boots are securely attached to the pants cuffs with cement, achieving an airtight effect, frowned on by Dior, but blessed by flyers who abhor seawater seeping into their socks!

## Note of Warning

A note of warning is sounded here. Be sure that the supply people know the correct boot nomenclature and can identify it correctly; otherwise, it just won't work. One of FLYING SAFETY's editors recently spent several musty hours culling through dozens of pairs of variously designed boots before it was discovered by the warehouseman that nobody in the place knew just exactly what the boot looked like. The M-4 suit isn't worth a square tissue paper without boots that can be sealed on!

The correct boot for the M-4 anti-exposure suit is the Type 4 boot, developed from a combat infantry model. This boot is worn over a light or medium sock *only*. Do not wear heavy wool socks with this boot. The
boot has a sealed air chamber fo
cold protection, and this chamber e
pands with increasing altitude. Ther
is a valve on the boot for venting t
relieve discomfort at high altitude

## Sizing and Attaching

It is most important that the wri
and neck sizing and the attaching c
the boots be done correctly, or th
suit is useless. These nine cardina
rules should be followed in order t
obtain watertight suit integrity:

- Always apply three coats of c
ment to a fabric surface.
- Always apply two coats of c
ment to a rubberized surface.
- Always allow one-half hour b
tween coats for proper drying.
- Never skimp on coats of cemen
Use it with a lavish hand.
- Never join two wet surfaces.
- Never join two surfaces unt
they are "tacky" (sticky).
- Always roll finished seams wit
a slow heavy pressure.
- When separating two surface
that have been cemented, alway
brush Ethyl Acetate into the area t
be separated.
- Always use powder (talc) on
surface when you have finished work
ing with it to prevent it from stickin
to another surface.

Whenever you are issued your ex
posure suit, be sure that the wrist an
neck seals are correctly fitted to you
individual measurement. A rule t
follow is to take your neck circum
ference, subtract 2½ inches from thi
figure, and divide by two. This wi

give you the proper neck circumference for your suit.

Care of your exposure suit is also important. It should be stored in a cool, well-ventilated place, never in the sunlight. Never try to make repairs to major damage. Turn in the suit, and be on the safe side. It is practically impossible to make watertight repairs of any sizeable nature.

So much for fitting the Mark IV.

Now, let's look at the business of wearing the suit. The first step in achieving the "Man from Mars" effect, is to don a suit of heavy woolen underwear. Over this goes your anti-G suit, if you usually wear one. As we said, be sure your socks are light or medium weight, and be sure to pass the G-suit hose through the opening provided in the liner. Then don the outer suit.

When you put on the outer suit, be sure to powder your hands and wrists well with talcum powder so your hands will slip through the holes easily. You get into the outer suit by spreading the suit in front of you, and putting your legs through the entry opening. Pass the G-hose through the left side of the suit. Insert your arms into the sleeves by putting the entire left side of your body into the suit first, and then the entire right side of your body. Grasp the neck seal firmly in both hands, spread it apart, and pull the seal over your head. Be sure that this seal lies flat against your neck. This goes for the wrist seals, too.

A word of caution. When you come o the boots, *pull* on the boots, and ot the fabric garment, lest the seal reak loose. Another warning . . . vhen you put on this suit, DO NOT PULL on the entry canopy material, ut on the suit fabric itself.

On the M-3 modified suit fasten he middle (colored) snap of the nner entry portal and then secure the ther six snaps. After you make cer-ain that the inner snaps are secure, oll the portal canopy as tightly as ossible by grasping the winding trips near the end.

When the canopy is completely olled, fasten the outer snap in place. ll M-3 suits are equipped with "DOT" snaps on the outer flaps, and hese will close only in one direction. he M-4 suit closure is similar to hat of the modified M-3, except that he flap is closed with two slide asteners. This flap is closed by first ipping the lower zipper, and then he upper zipper. Be sure to fasten the G-sleeve over the aperture. Now, put on your Mae West, parachute, and para-raft assembly.

**Arms are stretched high as leg length is measured in fitting anti-exposure suit.**

### Suits Have Buoyancy

Both the M-3 modified and the M-4 suits have a lot of positive buoyancy. This is due to the air that is trapped in the suit, the boots, and the insulating liner. The suit reaches zero buoyancy only when completely full of water.

If you go down in the drink, to facilitate swimming get into an upright position and release the trapped air by stretching the neck seal. If your suit is not torn, you will not need your Mae West.

The suit will permit exposure to seawater at freezing temperatures for approximately one hour. If you can keep your head warm, this time can be extended. Make use of your inner helmet and parka hood, and keep your head out of the water. Also, remember that your quick-donning exposure mitten gives protection for one hour before numbness occurs.

For survival on land, the suit assembly will give protection in subzero weather for an extended period of time. The Type 4 boot has been tested to minus 40 Degrees F., and is a comfortable walking boot, if properly fitted. The wrist and neck seals will continue to give protection on land, but if you get too hot, cut away the seals and replace by wrapping your neck wrists with torn strips of parachute cloth. ●

**It pays to wait for your IFR clearance. If the weather is doubtful, stop and consider ALL the weather factors involved enroute.**

# . . . file and fly I F R . . .

"COLLISION with hill, primary cause, pilot error."

This was the conclusion reached by the investigating board as a result of a recent major accident caused by a pilot's failure to use prior planning and good judgment during doubtful weather conditions.

However, there is much more behind this brief conclusion, "Collision with hill." Let's go through the accident report and look at the tragic facts leading to this accident.

The pilot of the aircraft landed at a municipal airport after completing the first leg of an instrument proficiency cross-country flight from his home base, less than 100 miles away. After filing his clearance for the return flight, the pilot and his student boarded the airplane and taxied out to takeoff position. He had filed an IFR clearance, and had requested a return route via airways part of the way, and direct to home base for the remainder of the flight. Air Traffic Control was unable to approve the clearance as requested by the pilot, and issued the following clearance:

> "Proceed to Sugar Radio, via Amber 1. Blue 14. ultimate route to be via Los Banos fan marker and Evergreen marker."

Since the pilot did not have enough fuel aboard to permit flying this route. (remember he had landed at a municipal airport where military service was not available). he did not accept the clearance. He taxied back to the line and managed to refuel on an emergency basis, anticipating that his subsequent clearance would be the same. After refueling, the pilot taxied out to position and requested another ATC clearance. The pilot was advised that ATC was not accepting any inbound flights for approximately one hour because of two existing emergencies. The pilot returned to the line again.

About two hours later, ATC advised the local tower that this particular aircraft could taxi out to takeoff position because an immediate clearance was available. At this point the tower advised ATC that the pilot had decided to return to his home base VFR. Here is where impatience undoubtedly entered the picture as a contributing factor. Weather at destination at this time was 600 to 1000 feet, visibility two to five miles.

At about 1600 hours the pilot departed from the municipal airport for his destination. At 1645 hours, the pilot called Approach Control at his destination, and reported that he was holding on the Northwest leg of the destination radio range, VFR at 2000 feet. He asked for further instructions from ARTC.

The pilot was advised that a clearance could not be issued at once, and he was instructed to remain VFR, and not to climb due to traffic in the immediate area. A few minutes later the pilot called Approach Control again, and reported that he was holding VFR in a *large hole in the clouds.* He added that this hole was closing up, and again requested instructions. It appears that an element of panic started to creep in at this point. The pilot was again advised that he could not be given a clearance, and again was advised to hold VFR and not to climb. *At no time did this pilot declare an emergency.*

A few minutes later, approach control tried to contact the pilot, but all attempts were unsuccessful. It was later discovered that the airplane had crashed about ten miles from the range station, on the Northeast course of the radio range.

It was the opinion of the investigation board that the pilot thought he was on the Northwest leg of the range, when he was actually on the Northeast leg of the range, and failed to maintain sufficient altitude to clear the terrain in that area.

The conclusion of the board was that the primary cause of this accident was the failure of the pilot to wait for an IFR clearance. The pilot also failed to consider all the weather factors involved, once he decided to clear VFR. When the pilot saw that VFR was difficult, if not impossible, to maintain and when he was not able to get an immediate IFR clearance, he should have declared an emergency right then and there. What the pilot failed to remember is that when the emergency presented itself, he should have *without delay* advised the controlling agency in such a manner as to leave *no doubt* as to the gravity of the situation.

Remember, that when you declare an emergency, or advise that an emergency is imminent, ATC will give you a Number One priority. While it is true that many pilots have an aversion to declare an emergency, based

**Sometimes it pays to take it easy. In marginal weather ATC may get overloaded with traffic and hold up your clearance. Don't try to save an hour and end up losing years by switching to VFR to expedite your take-off.**

o doubt on false pride, two other ilots had declared emergencies that ery afternoon in the same area.

What pilots should keep in mind is hat it is often impossible for the conrolling agency to issue routine IFR learances on short notice in areas here there is a high concentration f instrument flight activity. You hould remember that a request for n en route change of flight plan from FR to IFR should be made far nough in advance to insure a return the point of departure, or to an alernate *before* the emergency is there aring you in the face.

AF Reg 60-16 definitely states that order to aid in the establishment of traffic sequence by ATC, and to preent delays in departure of IFR trafc, operations personnel will, *if reuested by the pilot,* transmit a proosed flight plan to ATC centers at y time within two hours prior to e proposed departure of the flight. In such cases the pilot of the aircraft will be required to obtain his ATC clearance within one hour of the proposed departure.

Remember that whenever you enter an area of high traffic density such as is usually found around metropolitan areas, when weather sets in you are going to be in the middle of a rat race because you have not only scheduled commercial aircraft clearing into the control area, but you will probably find a private pilot or two tooling around in the overcast.

In this story, the pilot not only used poor judgment, lacked sufficient preplanning, but was evidently smitten with "homewardbounditis," plus a false pride which precluded his calling for an emergency.

Some AF commands have found that it actually cuts down the time element if the pilot files his IFR, and waits on the ramp until ATC clears him. It is then only a simple matter to taxi out and take off. Holding time in the slot is reduced; it is easier on the engines and it saves gasoline . . . to say nothing of an occasional neck.

This accident was needless. It was 100 per cent pilot error. It can't be blamed on the forecaster, the airways facilities, navigation aids, or mechanical failure. To make the story more amazing, the pilot was an experienced instrument instructor, and was thoroughly familiar with the area around his destination.

There is no explanation as to why this pilot, who certainly by this time could make an accurate range leg identification, should have been holding on the wrong leg, and why he should have been cutting his minimum altitude so thin, when he knew the surrounding area was full of large, solid rocks. We'll never know what went through this pilot's mind, but we do know this, and we pass it on to you . . . Haste Makes Waste Strewn All Over The Surrounding Terrain . . . and if you are in doubt . . . always FILE and FLY IFR.

### "Old Dad Says"

- *Plan your flight in advance.*
- *File your clearance early.*
- *Wait on the ramp for your ATC clearance.*
- *Don't be in too big a hurry to get home.*
- *Don't hold VFR in cloud breaks.*
- *Expect some confusion in congested areas.*
- *Be certain of your range leg identification.*
- *Check those rocks underneath.*
- *If in doubt file and fly IFR.*

# . . . . wherefore art thou?

**Even though blessed with new types of navigation equipment and radio aids some pilots still manage to make the same old mistakes that were made back in the road map days of flying.**

NOT too long ago, in the infancy of aviation, planning a cross-country flight was considered to be rather elementary. A pilot looked his map over for a likely highway or railroad running in the right direction, found a few outstanding landmarks more or less on course, cursorily checked the weather, cranked up and took off. He usually got where he was going but sometimes he didn't.

Those days of rule-of-thumb and "iron beam" navigation are long gone, fortunately. Today, a pilot or navigator has at his disposal navigational aids ranging from a radio compass to long and short range radar navigation systems. New, improved charts and a vast network of radio facilities have helped make modern aerial navigation a science of pinpoint precision, in direct contrast to the old pilotage system. But, in spite of all the new and improved navigational techniques, nearly four percent of all major Air Force accidents caused by pilot error are attributed to navigational errors. While the overall percentage isn't high, the figure, when converted into terms of loss of personnel and equipment, presents an important picture.

A study of accident reports involving navigational errors for a four and a half year period revealed the following primary cause factors.

- Poor flight planning.
- Failure of the pilot to attend briefings and failure to follow standard flight procedures.
- Poorly computed ETE; disregard of forecast headwinds, frontal conditions and adverse weather.
- Failure to practice cruise control and neglect in determining fuel consumption.

- Poor selection of alternate air- orts.
- Incorrect use of available in- truments and aids.
- Failure to take decisive action n turning back when continuation of he flight must be made under adverse onditions.
- Substandard proficiency and lack f knowledge and experience in nav- gational problems and procedures.

Many factors contributed to these ccidents caused by navigation er- ors. Pilots were guilty of using ob- olete charts, resulting in incorrect adio data. Others neglected to even ake charts on a flight. In several in- tances pilots on a VFR flight plan, ew into instrument conditions with- ut obtaining ATC clearances, even hen forewarned that the weather as marginal.

Several major accidents took place fter instrument letdown procedures ere ignored, and the pilot let down rough a hole in the overcast. Other ilots attempted to home in on radio ange and homer frequencies without rst making sure of identification gnals. This, of course, resulted in nding up far off course.

Other cases of poor navigational chnique and flight planning include iose in which flight leaders inade- uately briefed their flights. The ights went IFR direct instead of on rways. They used power settings o high for the distances flown, and ey failed to land when they found eir fuel low. Frequently a pilot re- ised to follow D/F steers which ould have brought him to his desti- ation. Failure to use all available uipment, and ignorance of pro- dures were also determining fac- rs in many accidents.

Investigation further revealed that any pilots were unable to orient themselves visually, even with excellent check points available. Testimony during investigation of many of these accidents indicated a definite inability on the part of many pilots to identify features of terrain on aeronautical charts.

Factually, it was determined that in accidents involving navigational error, about 50 per cent occurred after fuel had been exhausted. In jet fighters the rate soared to over seventy per cent; the importance of fuel conservation in jet navigation is best illustrated by the average length of flight prior to the accident being only one hour and 55 minutes.

Weather and night flying have been consistently associated with navigation accidents. Weather was a factor in nearly fifty per cent of the accidents, while forty-five per cent occurred at night.

Violations and supervisory errors also figured prominently in these accidents, contributing a relatively high percentage of the total. Materiel failure was virtually confined to radio failures and to inadequacies of radio range and homers.

The Medical Safety Division, Directorate of Flight Safety Research, has made several recommendations aimed at eliminating these needless navigation accidents.

Primarily, it has recommended that more stress be given to navigational proficiency of all kinds. A pilot should not be considered adequately trained till he is proficient in all navigational techniques. Refresher courses should be given to pilots to keep them current in all standard operating procedures, regulations and equipment. Proficiency standards, much the same as present instrument standards, should be established and all pilots required to keep current.

A further recommendation was that a standard operating procedure be adopted for all flights with greater emphasis on factors affecting navigation such as fuel consumption, landing conditions, wind, altitude and turbulence.

Finally, that a more strict adherence to regulations be stressed for routine cross-country and navigator training missions.

**ulty navigation left this iron bird nestled high and dry in the boondocks.**

## Good Flight Planning

- Check the weather carefully. It is a good idea to get the general weather picture and then obtain specific data as you are ready to enter it on your flight planning log.
- *Departure*—Get all the facts on takeoff, ceiling, visibility, freezing level, temperatures and winds up to flight altitude.
- *Destination*—Get an accurate picture of what the weather is and will be at your intended landing point. Ceiling, visibility, freezing level, tops of clouds and precipitation. From this you can determine whether it will be easy, difficult or impossible to get into the field. If it appears marginal, check the forecast against your ETA to see if the weather is deteriorating or improving and whether or not you can get in.
- *Route*—Determine the best route by studying available information on freezing levels, cloud types at various altitudes, tops of clouds, turbulence or thunderstorms, temperatures aloft and wind.
- *Alternates*—With a definite destination and a definite route picked out, check for alternates. Obtain the same information on alternates that you got for destination. Include a forecast for the alternates for the time you may have to use them and make sure that one will be available if needed.

  Flight Plan Information should include wind and temperature data.
- *Wind*—Get wind velocity and direction for each 2500 foot level and compute an average for each 5000-foot level.

# At your Flight Service—

**By Major Frederick H. Fahringer**
**Hamilton Flight Service Center**

*"No Emergency Equipment Located on Field—Call City Fire Department—Phone 42—Five Minutes From Field—Ambulance Service to City Hospital—Phone 98—Seven Minutes From Field".*

USING the emergency information instantly obtainable from the Field Survey File, the Operations Officer at Hamilton Flight Service Center alerted the Madera, California, Fire Department and City Hospital for the expected emergency landing of an Air Force B-25 at Madera Municipal Airport. As the B-25 approached the Madera Airport, the best equipment in the area was standing by to render assistance necessary.

Lectures assist pilot in achieving accurate and current interpretations of air traffic rules and procedures.

This expeditious handling of an emergency was made possible by the Landing Field Survey Service available from Military Flight Service (MFS).

The eight Military Flight Service Centers comprising the MFS system in the United States screen all landing fields in their respective areas not already covered by other (CAA or Military) pertinent publications and surveys. Fields are then selected for survey according to their location, capabilities for handling military aircraft and availability of facilities.

Every six months a Flight Service officer visits each field selected and conducts the actual survey. The surveying officer personally contacts the airport manager and obtains first-hand information on the status of the runways, hangar space, obstructions to approaches, night lighting facilities, radio aids, and emergency procedures. He then establishes liaison with the airport manager, requesting that the appropriate Flight Service Center be notified if any changes occur in the condition of the field.

These physical surveys, coupled with good liaison, provide Flight Service Operations with immediate, accurate and complete landing field information for emergencies.

One night recently, a CAA Communications Station picked up a "Mayday" call from a military pilot who described his predicament as "lost, and short of fuel." The communications station, unable to establish contact with the aircraft, notified the nearest Flight Service Center.

Each center maintains a weather display board depicting the latest weather by a system of coded lights.

As an emergency procedure, the Flight Service operations officer immediately checked the "Field Survey File" for all suitable fields along, and in the general area of, the intended flight path of the lost aircraft. From this file he obtained the information necessary to have the field and runway lights of these civilian fields turned on immediately. A short time later the lost aircraft made a landing at one of the "lighted" fields.

An F-51 pilot, with oxygen trouble, ample fuel, radio contact, and VFR conditions, *but* not familiar with this service, made an unsuccessful emergency landing at a civilian field with a dirt runway, 1900 feet long, when fourteen miles away sat 5000 feet of smooth concrete. The field survey file has repeatedly proved its value in aiding lost or distressed aircraft to safe landings at suitable airfields.

Besides its numerous emergency uses, this survey file can frequently take the "strange" out of a "strange field landing."

If your mission requires you to land at an unlisted, unfamiliar airfield, check through your base operations to Flight Service for detailed runway, approach, and communications facilities information. The only thing "strange" about a strange field landing is the pilot who fails to take advantage of this service.

> *"AF 1234, C-47, Over RBL ALT 10,000 IFR at 08 REQ MFS Advisory, 'Desire Alternate Procedure for Immediate Landing'."*

As the Oakland ARTC controller finished relaying this request, the MFS team, operations officer and weather forecaster, swung into action. Within seconds, the requested MFS Advisory was on its way to the pilot. Utilizing the MFS Advisory the pilot made a successful VFR landing thirty-two minutes later.

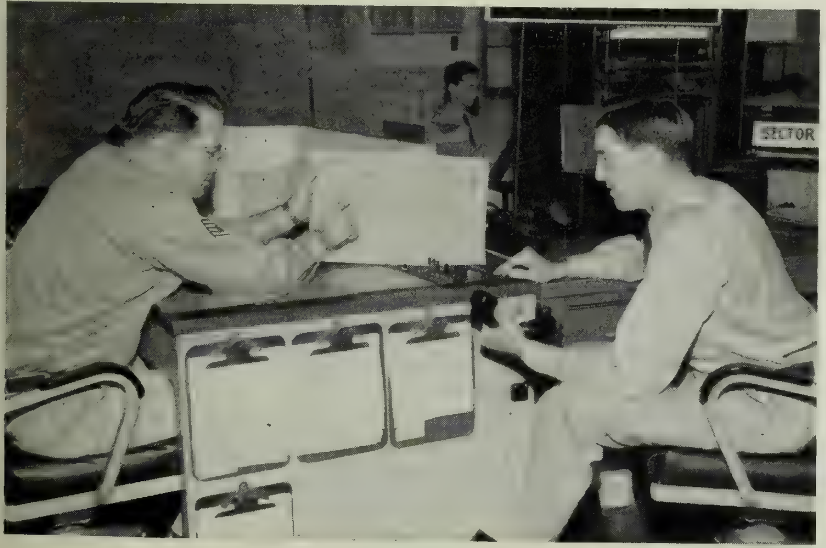
Although MFS no longer employs "flight following" with automatic advisory service, the capability of issuing advisories has been retained. Any competent authority, such as a pilot, base operations or weather forecaster, can request an advisory.

Each MFS Center maintains a weather display board depicting the actual, up-to-the-minute weather by means of coded lights. This display board gives the forecaster and operations officer a constant over-all picture of weather conditions throughout their area.

Constantly current and instantly available information on weather, landing fields, NOTAMS, and radio aids enables MFS to provide prompt, beneficial advisory service when requested. MFS advisory service is designed to provide the pilot with additional, pertinent flight planning information, not readily available from other sources. When the unexpected is encountered, a working knowledge and prompt, timely use of the Advisory service will go a long way toward reducing the emergency operations of the Air Rescue Service.

"The regulation's been changed since I last looked at it," or "That's not my understanding of the regulation," are still among the most overworked expressions employed by pilots attempting to explain violations of flying regulations.

**In an emergency, a survey file is checked for a suitable field in the general area. Below, an MFS advisory is sent out at the request of a pilot.**



In an effort to eliminate these expressions, MFS can materially aid Base Flying Safety Officers by an educational program. Such a program is designed to assist pilots and operations personnel in achieving accurate interpretations and understanding of air traffic rules and procedures.

A qualified MFS officer and an experienced CAA representative from Air Route Traffic Control will travel to any military base to conduct a lecture when requested. These lectures include all aspects of military and CAA air traffic control procedures and regulations. If desired, the program may include a discussion period at which time individual questions may be asked. Frequently, Base Operations personnel take advantage of this visit to discuss and coordinate local traffic control problems.

Put the Service in Flight Service! Take full advantage of the readily accessible aids provided by MFS for your convenience, efficiency, and safety. The sky is no longer big enough to take care of "individual" pilots. Today, air safety can be achieved only with expert traffic control and competent, disciplined pilots.

★ ★ ★

## Pilot Procedures

If your flight is departing a "P" field, file your flight plan with Flight Service through CAA communications and if it is IFR within a control zone or area, get ARTC clearance.

In leaving "PC" fields, fly VFR to the closest CAA radio and file your flight plan. If it is IFR within a control zone or area, again, call the closest CAA communications station. For a change en route, call CAA radio, if IFR get ARTC clearance.

In changing from IFR to VFR or DVFR, advise the nearest CAA radio or approach control of cancellation of your IFR flight plan *before* departing from the provisions of ARTC clearance. DVFR flight plans will be filed if any portion of your flight lies within or penetrates an ADIZ. To change from VFR to IFR, call CAA radio and get ARTC clearance.

For ADIZ flights, file your flight plan *prior* to takeoff either in writing or by telephone with appropriate aeronautical facility for any flight, all or part of which will be flown in an ADIZ. Designate VFR flights as DVFR, and include route and altitude while within an ADIZ. Do not change your flight plan to enter an ADIZ zone except in emergency. ●

# Keep Current

NEWS AND VIEW

• **117 Soft Landings**—Pictured below is a pair of tires recently taken off a T-33 assigned to the 1002nd Inspector General Group. According to M/Sgt Keck, who crews the airplane, this is some sort of a record, and is certainly a compliment to the ability of the pilots who fly this Thirty-three and to the men who maintain it. In view of the fact that the airplane has been used a great deal of the time for transition work, the 1002nd's policy of thoroughly indoctrinating pilots before and during T-33 transition training seems to have paid off.

We don't say that this is a USAF record but if you have definite proof of a set of jet tires that have lasted longer than 117 landings, give us the ungarbled word, and we'll print it!

• **New F-86-F Wing Design**—Every F-86-F pilot should read and remember this item!

The wing slats that have long been associated with the F-86 have been replaced by an extended leading edge starting with F-86-F-30, Airplane No. AF52-4505.

The root of the new leading edge has been extended forward six inches, and the tip extended forward three inches. This new leading edge improves high speed performance and turning performance.

It is interesting to note that no increase in the maximum obtainable G is gained with the new leading edge; however, the fact that the airplane can more closely approach the maximum G before buffet starts, makes possible better maneuverability at high altitudes. This is because the drag rise incidental to buffet inception is delayed, resulting in less speed loss during flight.

The extended leading edge increases stalling speed and brings about a yaw-and-roll not noticed on slat-equipped airplanes.

The coverage now contained in the February 20, 1953 revision of AN 01-60JLD-1 on this subject will be expanded. The specific differences in flight characteristics between F-86-F Airplanes with wing slats and F-86-F Airplanes with extended leading edges are as follows:

### *Low-Speed Stall*

A yaw, accompanied by a roll precedes the stall on airplanes with the extended leading edge. To avoid this yaw-and-roll tendency, it is recommended that *10 knots* be added to the touchdown speed used with slat-equipped airplanes (120 knots in minimum for extended leading edge airplanes at normal landing weight). Also, note that any G forces abruptly applied during flare out for touchdown may cause a wing to drop. Landing patterns should be widened out with respect to those used for slat-equipped airplanes to avoid dropping a wing on the turns (150 knots minimum at normal landing weight). There is very little stall warning under landing conditions.

*NOTE:* It is highly recommended that the stall speed chart in Section VI of the F-86-F Flight Handbook b carefully reviewed in order that th effect of varied weight conditions an angles of bank on stall speeds b thoroughly understood.

Buffet preceding an accelerate stall will begin at a higher G on extended leading edge airplanes. Ther is no noticeable difference in high speed stall characteristics when abov the buffet initiation point.

On airplanes with the extende leading edge, a change in airspee from trim requires less stick forc than on airplanes with wing slats

Maneuverability at high altitude is increased on airplanes with the extended leading edge because more G can be pulled before the initiation o buffet. Although the maximum G obtainable (as limited by buffet magnitude) remains unchanged with th extended leading edge, less speed i lost during maneuvers, since the drag rise from buffet is delayed.

On airplanes with the extended leading edge, it is possible to turn in a smaller radius without losing speed as rapidly at higher altitudes. This is because the turn can be tightened considerably before buffet is encountered. For example, at 0.92 Mach. number at 30,000 feet, an additional 1½ G before buffet can be pulled; and at 40,000 feet, additional G can be pulled.

Because of the higher available load factor before buffet initiation on airplanes with the extended leading edge, familiarization with airplane response during rapid pull-outs is recommended, particularly in the medium altitude range (15,000 to 30,000 feet).

The recommended horizontal tail trim setting for airplanes with the extended leading edge is two inches forward of that recommended for airplanes with slats. To trim the horizontal tail for takeoff on airplanes with the extended leading edge, trim until takeoff trim position indicator light is "on" then trim until stick grip moves two inches forward of the trim light "on" position.

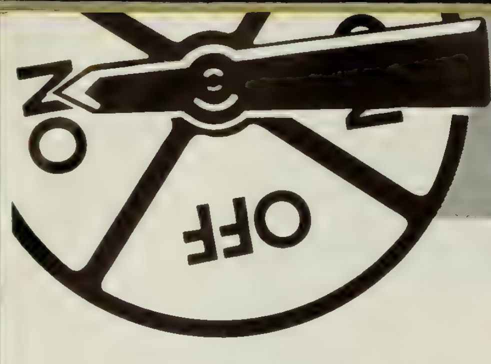
# WELL DONE!

### To 2/Lt. Robert V. Thomas

**Thirty minutes out from destination, the right main gear on Lieut. Thomas' C-82-A dropped from the nacelle and hung several inches from locked position. All emergency procedures for locking the gear down were attempted, with full cooperation of the copilot and the engineer.**

**Although Lieut. Thomas had a total of only 560 flying hours, he demonstrated superior pilot technique in bouncing the left gear on the runway surface hard enough to shake the right gear into locked down position, and made a successful landing without damage to aircraft or injury to personnel. Well done, Lieut. Robert Thomas!**

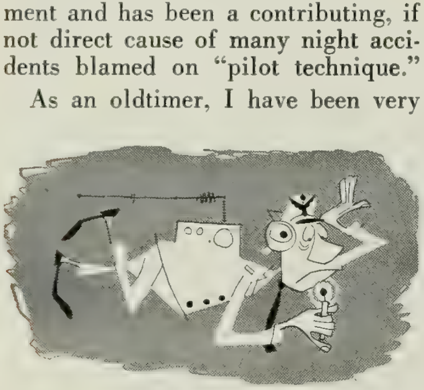
A SUDDEN FLASH OF THE RED "UNSAFE" GEAR POSITION LIGHT WAS THE FIRST INDICATION TO LT. THOMAS THAT THE RIGHT LANDING GEAR OF HIS C-82 HAD DROPPED FROM ITS NACELLE AND WAS HANGING SEVERAL INCHES FROM THE DOWNLOCKED POSITION ....ATTEMPTS AT RAISING REVEALED IT TO BE FROZEN......
AN EFFORT TO PULL THE LOCKS INTO POSITION WITH THE STIRRUP HANDLE RESULTED IN FAILURE OF THE CABLE....ALL EMERGENCY PROCEDURES ATTEMPTED BY THE CREW AND THOSE RELAYED BY THE SQUADRON C.O. AND A MAINTENANCE CREW FAILED TO HAVE ANY EFFECT ON THE GEAR.........
AS A LAST RESORT IT WAS SUGGESTED THAT BY CONTACTING THE RUNWAY WITH THE AIRPLANE IN A LANDING ATTITUDE TO START THE WHEEL SPINNING THEN PULLING UP WITH A SUDDEN STOPPING OF THE ROTATING WHEEL MIGHT FORCE THE GEAR TO LOCK. ....THE REMAINING FUEL WAS USED AND THE AIRPLANE CHECKED WITH THE POWER SETTINGS DECIDED UPON..
WHILE IN A HALF LANDED, HALF FLYING POSITION CONTACT WITH THE RUNWAY WAS MADE...IMMEDIATELY THE CREW FELT THE GEAR LOOSEN.... A PULL UP WAS MADE AND THE BRAKES APPLIED.....WITH A JOLT THE GEAR SNAPPED INTO THE LOCKED POSITION .... AFTER A GO-AROUND A NORMAL LANDING WAS MADE.....A WELL DONE TO LT. THOMAS AND HIS CREW!



# Cross Feed

## Cockpit Lighting

After reading Captain Schreffler's article, "Seeing Red in the Cockpit," in the April Flying Safety magazine, I feel I must express my congratulations to the Captain and to Flying Safety for this timely article. I could not agree more strongly that cockpit lighting is badly in need of improvement and has been a contributing, if not direct cause of many night accidents blamed on "pilot technique."



As an oldtimer, I have been very favorably impressed with the work you are doing to try to correct the contributing elements that too often are overlooked in accident investigations. May I let my hair down to mention a few items which I feel have bearing on this problem?

Today, there are thousands of Air Force pilots in staff jobs who are performing "proficiency flying." The aircraft available to us are usually, as Captain Schreffler stated, World War II C-47's, B-25's, C-45's, T-6's, etc. The instrument panel lighting in many of these aircraft is so bad as to put a severe handicap on the pilot performing normal night flying. I feel it actually constitutes a serious hazard to the pilot caught in night weather conditions. Not only are all the defects mentioned by Captain Schreffler true, but are usually emphasized in administrative and proficiency type aircraft. For example, the average B-25 fluorescent lighting is woefully inadequate. On top of bad lighting, all of these old aircraft usually have one or more instruments on which the radium is worn off, making the instrument dim. These are usually the most vital instruments needed for IFR flight. Why they cannot be replaced is beyond me, but it seems they never are.

Then there is the naive habit of hanging the pilot's microphone smack on the front windshield. Here it bobs around and is anything but helpful to the pilot trying to spot an approaching jet, or trying to land in rain, or at night. Yet, nobody can seem to get authority to move the darn thing.

Pilot visibility is also frequently cluttered up with unused gunsight brackets, and other impedimentia. All these things add to the night vision problem. Also, the B-25 has no windshield wiper, presumably because of the curved glass, but plenty of cars and trucks with curved windshields have them, and I don't believe it would be any great task for AMC to design one. The cost compared to one accident is infinitesimal.

Consideration might also be given to some sort of portable oxygen equipment that a pilot could draw from supply, like a parachute. This would help him on IFR flights when he is unexpectedly forced to oxygen level altitudes. It is hard to say when proficiency aircraft will ever be oxygen-equipped, and in the meantime we are all fooling around under marginal conditions, because if we played the game right we would never get off the ground due to lack of equipment in the airplanes. This is particularly true of flights made in the western United States where the terrain altitude is higher.

There appears to be a definite need to bring our World War II airplanes up to a higher standard. Pilot visibility, cockpit lighting, oxygen, and better radio are some of the needed items. Today's IFR flights demand two good receivers. Our Army friends have OMNI in most of their administrative aircraft, yet we still struggle along with a "Bird Dog" and a command receiver, and usually one of these is not working too well.

A partial cure may be more strict inspections, or closer coordination between Flying Safety Officers and inspectors, but I think the real answer is to get somebody with authority to *do something* about the defects which your magazine so ably points out.

**Colonel F. H. Colby**
**AF Liaison Officer**
**Hqs. 4th Army**
**Fort Sam Houston, Texas**

## Magazine "Great Help"

It is felt that your articles in the March 1953 issue of Flying Safety on Weather has good possibilities as instructional aids. Please send us 200 copies . . . to supplement our program at this station . . . if not available we will reproduce locally.

Most of the pilots at this station feel that editions of Flying Safety such as the March 1953 issue devoted to Weather are of great interest and help in extending the pilot's knowledge of weather. This is especially true with the upper air regions as expressed by the pilots flying jet aircraft.

**Robert G. Koch, Maj.**
**Director of Academic Tng.**
**Bryan AFB**

## Used as Training Aid

Please send us 200 copies of March 1953 Flying Safety. These additional copies are to be used by the Director of Academics, for the ground school training program.

**Roy E. Gardner, Capt.**
**3615th Pilot Tng Wg**
**Craig AFB**

## "Chuck Full"

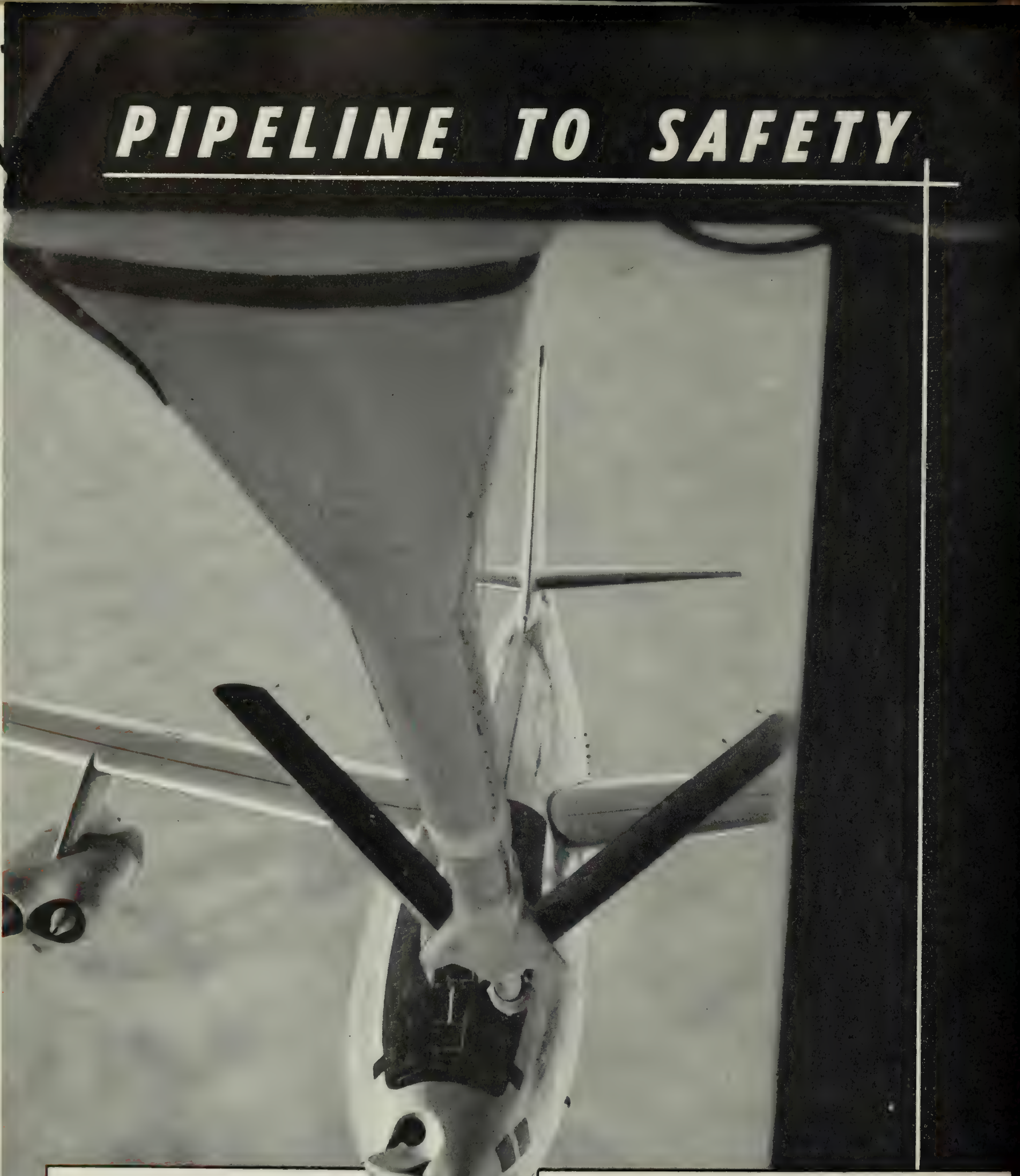
Personnel of this Flight Service Center think your publication is "chuck full" of valuable information.

**Vernon E. Bonsett, Capt.**
**Asst Operations Officer**
**WPAFB Flight Service Center**

## Don't Take Off Like a Rocket!

Everyone wants to get where they are going as quickly as possible but the wise pilot makes haste slowly. If the weather is marginal, wait for that IFR clearance from ATC. Don't forget, those ATC boys get pretty busy during bad weather but you will get your clearance as soon as possible. The impatient pilot who switches to VFR to avoid delay may find himself on the receiving end of a large explosion . . . *and end up with a loud bang!*

# PIPELINE TO SAFETY



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# FLYING SAFETY

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**FOR SALE:** ***Air Rescue Service . . .*** **see page 23**

# FLYING SAFETY AWARDS

Headquarters USAF and the Directorate of Flight Safety Research announces the six Flight Safety Awards for the period June through December 1952.

The newly designed plaques are extremely impressive, as is the accident prevention program record behind each of the winners.

FLYING SAFETY proudly salutes the six winners with a "Well Done" for outstanding achievement.

●

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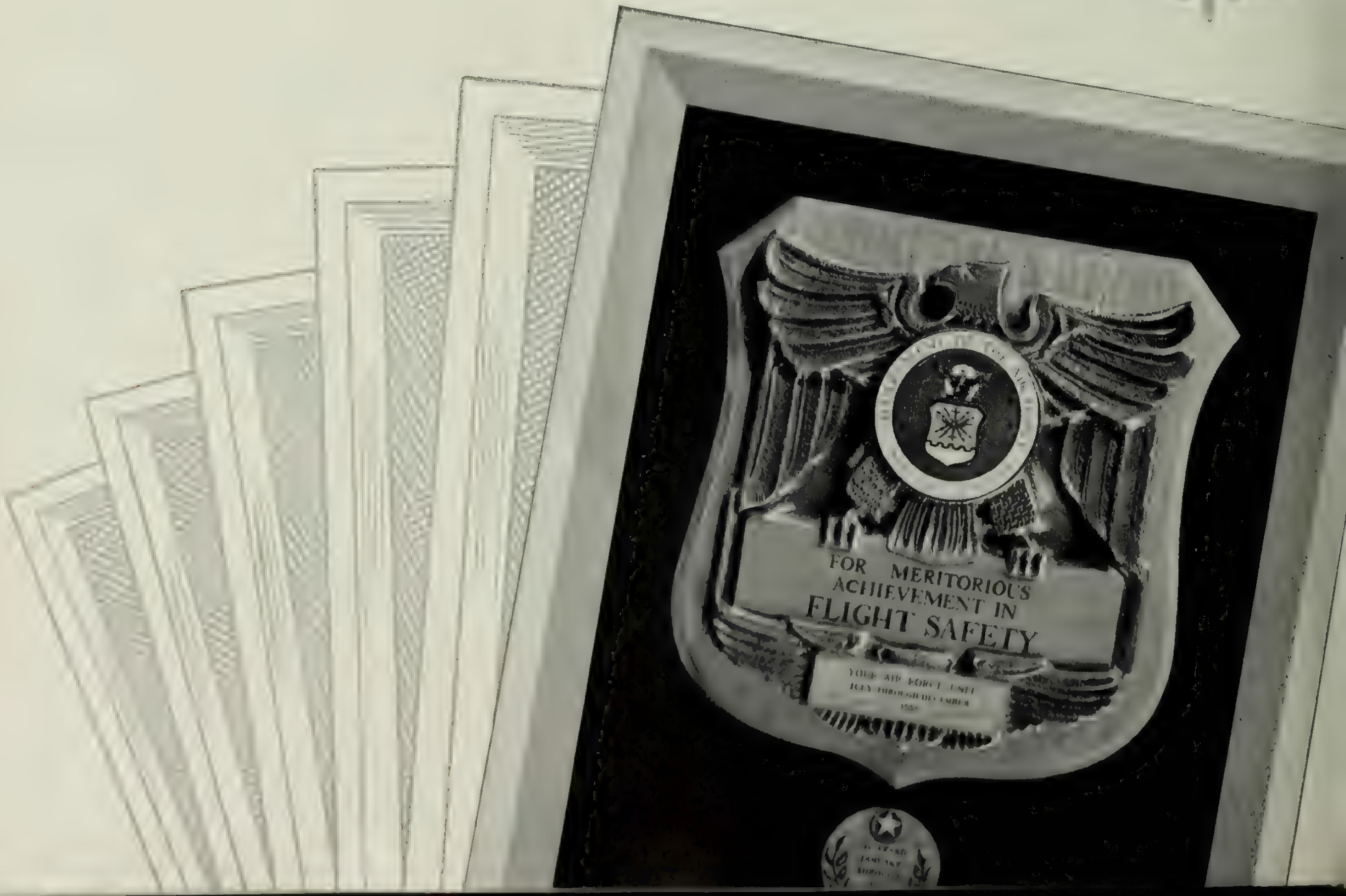
**Otis Air Force Base (Jet)**

**Rhein-Main Air Force Base**

**Hickam Air Force Base**
**(Pacific Division, MATS)**

**March Air Force Base**
**(Strategic Air Command Units)**



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The Inspector General USAF
ajor General Victor E. Bertrandias,
Deputy Inspector General

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igadier General Richard J. O'Keefe
Director
rectorate of Flight Safety Research
Norton Air Force Base, California

★ ★ ★

Colonel John R. Dahlstrom
Supervisor of Flight Safety
Publications

★ ★ ★

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**Capt. Bill Moranville is surrounded by the equipment and personnel needed to put him through the test pilot school at Edwards AFB. The story is on page 14.**

# Sand IN YOUR SHOES

***Fear . . . Ignorance . . . Stupidity . . .***
***These are the major obstacles to survival.***

By Alonzo W. Pond, M.S., Chief, Desert Section
ADTIC, AU, Maxwell AFB, Ala.

*The Arctic, Desert, Tropic Information Center of the Research Studies Institute is charged by the Air Force, "to accumulate, evaluate, and disseminate information about the non-temperate areas of the world." This sounds like an "ivory tower" kind of an organization . . . except for that little word, "evaluate." Many people dream up ideas on survival, some even write books about these dreams. The job of ADTIC is to make sure that information distributed to Air Force personnel comes from reliable sources, and that it fits field conditions.*

*The people who work in ADTIC are men who have left their "ivory towers" of learning, to spend considerable time in the field of their special areas of knowledge. Our tropic men have canoed and walked the jungles. They have flown over the green hills, and have hiked and camped within them. Men in the desert section have travelled by camel, motor car and airplane over the deserts of Asia, Africa, Arabia, and the Southwest United States. Each man has had from 12 to 28 years of field work plus academic training.*

*This article was prepared for* FLYING SAFETY *because ADTIC believes that ignorance about the desert and ignorance of the body's need for water are the greatest hazards to airmen forced down in desert areas. In the desert, a little learning . . . or a little ignorance . . . is often fatal.*

PAUL H. NESBITT
*Chief, Arctic, Desert, Tropic*
*Information Center.*

**Even among sand dunes there are flat areas suitable for emergency landings. These basins often contain wells.**

| MAX. DAILY SHADE TEMP. OF °F | | NO WATER | 1 QUART | 2 QUARTS | 4 QUARTS | 10 QUARTS | 20 QUARTS |
|---|---|---|---|---|---|---|---|
| 120° | RESTING | 2 DAYS | 2 DAYS | 2 DAYS | 2.5 DAYS | 3 DAYS | 4.5 DAYS |
| | WALKING | 1 DAY | 2 DAYS | 2 DAYS | 2.5 DAYS | 3 DAYS | |
| 110° | RESTING | 3 DAYS | 3 DAYS | 3.5 DAYS | 4 DAYS | 5 DAYS | 7 DAYS |
| | WALKING | 2 DAYS | 2 DAYS | 2.5 DAYS | 3 DAYS | 3.5 DAYS | |
| 100° | RESTING | 5 DAYS | 5.5 DAYS | 6 DAYS | 7 DAYS | 9.5 DAYS | 13.5 DAYS |
| | WALKING | 3 DAYS | 3.5 DAYS | 3.5 DAYS | 4.5 DAYS | 5.5 DAYS | |
| 90° | RESTING | 7 DAYS | 8 DAYS | 9 DAYS | 10.5 DAYS | 15 DAYS | 23 DAYS |
| | WALKING | 5 DAYS | 5.5 DAYS | 5.5 DAYS | 6.5 DAYS | 8 DAYS | |

**The tables shows days of expected survival based on three conditions: These are, amount of water, temperatures, and rest versus walking by night till exhausted.**

THERE is one outstanding, important factor about survival. It is present in every survival incident whether the incident occurs in the desert, the tropics, or the Arctic. It is *your will to survive.*

Without the will to survive, men have frozen in the Arctic when warmth was at hand. They have died in the deserts of Arabia when water was within reach. They have committed suicide in the jungles of Burma when help was available.

With the will to survive, men have lived and reached safety under fantastic conditions. They have survived with no more equipment than their bare hands. A prospector in the deserts of southwestern Arizona traveled 150 miles in eight days without water. Part of that time the temperature was over 120°F. He lost 25 per cent of his weight—nearly twice the dehydration normally considered fatal at that temperature. He crawled naked the last eight miles of his journey. His blood was so thick that lacerations on his arms and legs did not bleed until after the doctor got considerable water into his belly. He lived by the grace of God and his will to survive.

You too might survive in the desert with nothing but your will to survive. It has been done, but you can increase your chances to live and tell about it if you have three assets to survival:

- ☆ Knowledge to survive.
- ☆ Equipment for survival.
- ☆ Intelligence to survive.

Your knowledge should include as much know-how on outdoor living as you can accumulate. Air Rescue Service personnel say that country boys, or city boys who have had a lot of Boy Scout training, are the best survivors. They not only come out alive but they survive in good health.

Your knowledge should include all you can learn about the area in which you are stationed and the areas over which you may have to work. Knowledge of the people who live in those areas is excellent life insurance. Remember when you become a survivor, you are the foreigner in another people's "home town." It is up to you to know *their customs.*

The Air Force furnishes equipment for survival. It is well worth the space it occupies. It is insurance on the investment the Air Force has in you. How much that insurance is actually worth depends on your knowledge of how to use that equipment.

It takes intelligence to survive in good health. Use the intelligence that God gave you. Start planning on what you would do IF and WHEN. Plan to take advantage of circumstances.

Fear of the unknown—fear of discomfort — fear of people — fear of your own weaknesses. These fears are like calling two strikes on you before you step to the plate. You can eliminate fear with a little knowledge.

Unless you are a born crybaby, you'll find discomfort can be endured. It is seldom as bad as you feared, anyway. The people you are afraid of will turn out to be "good Joes" when you get to know them. The wild animals, which scare the daylights out of you by their noises at night, will run when they smell you. A little planning and thinking about survival now will eliminate your weaknesses and your fears.

Ignorance is a sure handicap to survival, but "ignorance of the law is no excuse." It won't stand up as a plea for leniency in any survival court. It is a sure way to get a maximum sentence of hardships in a survival experience. Get rid of your ignorance about survival problems.

Stupidity is the greatest hazard of all. If you are just plain stupid, there isn't much hope for you. The Air Force supplies the best equipment available. You have every material advantage possible for healthy survival. If you are too stupid to take along a survival kit on every flight—If you are too stupid to get on well with strange people or too dumb to take advantage of the breaks that come your way — if you are that stupid, don't blame the Air Force.

When you face the desert on its terms rather than your own, you will find the wasteland intolerant of carelessness and merciless in punishment for mistakes. Often in the past it has demanded the payment of a life for a lesson learned too late.

Rest is important in survival. When you have a job to do or a problem to think out, you need energy. Plenty of rest will increase your efficiency, allow you to walk farther and think more clearly about escape.

Time is not a factor in survival. The Air Force will get you out if you do your part intelligently. It may take a week—it may take six months, so you must rest and be patient.

There are scores of deserts in the world. Every continent has some and they occupy almost one-fifth of the earth's land area. However, only about four per cent of world population lives in desert regions. That may explain why, for centuries, deserts have been shrouded in mystery, cloaked in romance and wrapped with mythical terrors of sandstorms and mirages. Few people lived in them, still fewer had reason to travel there. Nobody knew the truth.

Far left, good condition and plenty of water can spell life in desert survival.

Your life may depend on your behavior when you arrive at a native village.

Don't strip. Clothing helps keep you cool by condensing body perspiration.

Many flight routes for civilian and military planes cross extensive desert regions. Some of these regions have become strategic locations for air bases. Oil wells and oil pipe lines have made deserts into travel areas for technicians, executives, administrators and diplomats. All these factors increase the possibility that some day you may find yourself in need of desert survival information.

In spite of their new strategic and commercial importance, ignorance and misinformation about deserts are still far more common among people of temperate climates than facts or understanding. For example, most people think that the Sahara is a sea of sand. Actually, only about 10 per cent of that great desert in Africa is sandy. The proportion is similar for the other major deserts of the world.

Contrary to general opinion, most deserts are not near the Equator. The major desert regions are between 15°N and 45°N. All are hot in summer at midday. Official Sahara temperatures have reached a record 134.4°F, and 120°F is a common daily reading from June to October. In the Gobi of Mongolia, temperatures in the high nineties are common in July and August. Temperatures in all deserts get down near freezing before sun-up on winter mornings. In the Gobi, winter temperatures often go down to 20° below zero.

If you could pick your own time for a desert survival episode, I'd suggest March to early May and October-November for much of the Sahara. Those periods are less likely to be unbearably hot or insufferably cold. In the Gobi, except for almost incessant wind, late May through June is probably the least rugged time.

Extreme daily range of temperature is just as characteristic of deserts as hot summers. In the Sahara the daily range is 45°F or more. In Mongolia the difference between early morning and noon is 25° to 35°F.

Extreme daily temperature variation means that you need clothes to keep warm in the desert just as badly as you need clothes to keep cool and to prevent painful sunburn even when you have a good coat of tan. Some survivors found the desert floor so hot at midday that their feet were blistered through their shoe soles.

When the free air temperature climbs above 92°F, your body begins to absorb heat from the air. You can also absorb radiant heat direct from the sun and reflected heat from the ground. The extra heat load added to the normal heat production of your body presents one of the major problems in your desert survival experience. That problem is water.

You can live a couple of months without food. Without water you measure your life span in days.

The normal temperature of the human body averages 98.6°F. Temperatures above that are recognized as fever. People have survived for a little while with body temperature of 112°F, but 104°F is considered critical. Fever temperature means lowered efficiency even when it isn't critical. You can't do as many foot-pounds of work per hour, you can't think as clearly or have as good judgment with fever temperature as with your normal 98.6°F.

In keeping you alive your body processes produce enough heat, even when you are completely at rest, to raise your temperature 2°F an hour unless that extra heat is removed. You can get rid of the extra heat by sitting in an air-conditioned room. Your body, however, has an efficient cooling system which operates under normal conditions. The evaporation of sweat on your skin surface keeps your body temperature normal.

Every hundred calories of heat produced by or added to your body from work, sun, air, ground or any other source require the evaporation of six ounces of water on your skin surface to keep your temperature normal. A man standing in the sun at a free air temperature of 100°F. will absorb enough heat to require 18 ounces (3 small glasses) of drinking water per hour to balance. If he sat in the shade of an army tent with sides rolled up 4 feet to permit air circulation, his water need would be only 7 ounces in the same hour. More perfect shade, as in a small cave, will give even better protection.

The Arabs and other desert people don't know anything about calories or the physiology of man in the desert, but they have learned the value of water, the importance of shade, and the wisdom of traveling at night or in the cool of morning. They also wear loose clothing which allows the sweat to evaporate efficiently (not too fast), and protects them from sunburn and from absorbing outside summer heat as well as keeping them warm in cool weather.

During WW II, Dr. E. F. Adolph and associates carried on extensive experiments with troops in North Africa and in our own southwest desert area. They worked out tables of expected survival time for a man with limited water supplies at different desert temperatures.

If you have no water at all, you can expect to survive for two days in summer desert temperature of 120°F —if you stay in the shade all the time and do no walking. Every ten degrees cooler adds a day to your life expectancy. At 70°F., or below, still with no water at all, you can look forward to ten days. This direct relation between your water needs and the temperature of air around you is important. "How long can you survive in the desert?" is answered by two other questions: "How hot is it?" and "How much water have you?"

**Be prepared to aid your rescuers with signals. Desert visibility is usually poor.**

Walking at night until exhausted and then resting when you have no water reduces your survival time to one day at 120°F., or 7½ to 8 days when the thermometer registers a cool 70°F, or less. The charts also show that there isn't much improvement in your expectancy at temperatures of 110°F, or more until you have at least a gallon of water. In high summer heat, each gallon adds another day. At 90°F, and lower, each quart will mean another day.

During the Adolph studies they did not kill off any of their subjects. However, actual emergency records in WW II and later have given us a few checks on the reliability of Adolph charts. Three U. S. soldiers died in the Persian Gulf area during the war from dehydration. Two Arabs died from the same cause in Saudi Arabia in the summer of 1950. Known conditions in both cases showed the men had lasted two days without water.

In North Africa the experience of four men from the Long Range Desert Group indicates reasonable accuracy for the Charts on survival time at winter desert temperatures. This incident occurred in the winter of 1940-41, so it is probable that daytime temperatures never reached 90°F. The men started with 2.5 quarts (U.S.) of water each. Some water was dropped to them by air, but spilled out. How much they got is not of record. All four men were rescued on the tenth day. One had collapsed and was delirious when rescued and another died after rescue. The third reached shelter the seventh day and stayed there until rescued. Only the fourth man was still going strong on the tenth day of his trek.

One crew with whom I flew 21 hours over all types of Sahara Desert terrain decided "If we ever get in trouble over the desert we'll ride the plane down. We'll need the water, the equipment and the shelter the plane can provide." These men have taken the first step toward a successful desert survival experience if they ever encounter one. They plan on having as much water as possible. They plan on utilizing the shade and the equipment a grounded, even a wrecked airplane can supply. They know the value of shade in extending their survival time and in reducing the body's need for drinking water.

Water is so important that we'll return to it again after discussing some other desert problems. One of these is visibility. The Arabs say "Three things you cannot hide in the desert: smoke, a man on a camel, and a man in love." You will probably not be concerned by the latter under survival conditions. I can't wholly agree with the second, for I've seen camels disappear before my eyes in the Sahara and wondered how they got out of sight so fast. At any rate smoke and dust are visible.

The desert handicaps the visibility of those not specially trained as desert observers. Difference in air density in the cool of early morning and in the heat of midday distort light rays and produce mirages. The more common one is the "lake with islands." The apparent water on the black top highway in the States in summer is the same type. I've seen these mirage lakes so realistic in North Africa that auto passengers refused to believe there was no lake until the car ahead stirred up a cloud of dust where the water seemed to be. Another type of mirage makes mountains appear three times as close as they really are. The third, the rarest and most romantic, is the "inverted city in the clouds."

Seeing mirages does not mean you are going crazy. The apparent objects may not exist in three dimensions where they seem to be, but optically they are real enough to register on camera film, so it is not surprising if you're fooled, also.

These different air densities also distort visibility. A woman on horseback in the Gobi may look to you like a telephone pole but the local Mongols will recognize horse and rider. Other objects may be similarly distorted so badly that you do not see them at all, like the camels that did a disappearing act for me.

Desert glare, short shadows, and the fact that desert buildings are built of the desert soil all tend to hide objects. The summer sun is so nearly overhead in many desert regions that shadows are relatively short for a longer period before and after noon than in regions farther from the equator. The absence or scarcity of vegetation increases reflected light and glare so that your eyes do not recognize the shadows. This is especially true if you do not wear sunglasses. The glare may or may not be painful to you—individuals vary in their tolerance to glare. Whether it hurts your eyes or not, it does cut down your effective desert vision, and the hang-over reduces your ability to see at night.

If you want to be invisible in the open desert during the day, keep a hill or even a very slight elevation between you and possible observers. The mirage will then give you protection. Keep in the shade of anything you can find.

When you want to attract attention, kick up a dust, use a signal mirror or blow a whistle. Your unaided voice is easily lost in the vast space of the desert. White and blue colors are not easy to see at a distance. The most visible color in the desert, as at sea, is luminous red. Tarpaulins so colored really stand out to a rescue plane.

Your most effective daytime visual signal is a signal mirror. Learn to use one now. If you don't see or hear a rescue plane just flash your mirror toward the horizon. Don't blind the pilot while he is trying to land. Give him a break. After he lands, you can again attract his attention with the mirror. He might not be able to hear your voice or your whistle if his engine is still running.

At night (and it can be black in the desert) your signal problem is one of light. Build a fire if fuel is available; use a flashlight, if available, but don't waste batteries. Save the power until you hear a rescuer.

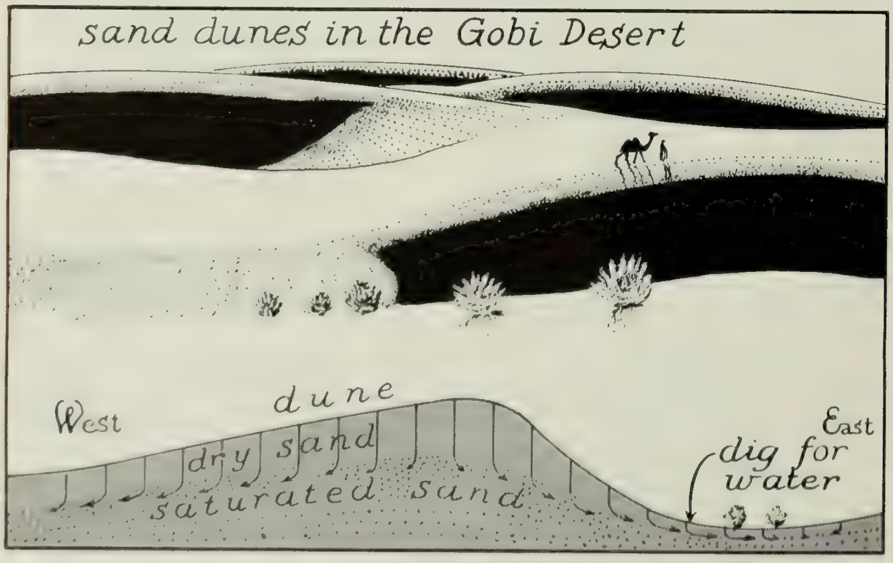
At midday your voice will not carry far, but in early morning voices often carry considerable distances. Then, shepherds on the edge of the desert call out the news from hilltop to hilltop. In the semi-desert high plateau region of Algeria, North Africa, I have often heard two boys a mile apart exchange news of their camps, always early in the morning. I've never heard them waste their breath when heat waves quivered above the earth.

Wind and the accompanying sandstorms are annoying desert phenomena that can reach serious proportions. April, May and June are windy months in the Gobi. It blows from soon after sunup till about sundown. It starts again, often in the opposite direction, soon after sundown and blows till sunup. In grasslands it may not raise dust, but the wind gets to be a personal force you hate.

When wind comes from the right direction over loose desert material, the resulting dust storm will fill your pockets, your watch, your eyes, your nose, your throat with dust and grit. Sometimes the sand will pelt you with force enough to sting your legs and arms even through your clothes. Sandstorms sometimes last for days and carry dust up over 10,000 feet altitude. Such storms become navigational hazards to an airborne plane.

If you are on the ground in a sandstorm, remember—no matter how annoying and uncomfortable it may be—it is not a Dakota blizzard. You will not be buried alive. You are more likely to get lost trying to travel in visibility zero. If you are traveling, mark the direction of your route with a large arrow dug in the earth or with a long row of stones—at least 3 feet, better 30 feet. Then get in the lee of any shelter possible. Turbulent air may exist on the edges of your shelter but you should find it fairly comfortable near the center. Any respite is preferable to the blasting force of wind in the open desert.

**In sand dunes areas, water may be located by digging at the base of the slope.**



If no shelter is available, after you have marked your directions, lie down with your back to the wind, roll up in your parachute, and weather the storm as comfortably as you can.

Sleep out a sandstorm, if possible. It is the least unpleasant way. It offers the fewest hazards and the least strain on your body. No search plane will be looking for you until the storm is over, whether it lasts one day or one week, so get all the rest you can and be in good shape when the weather clears.

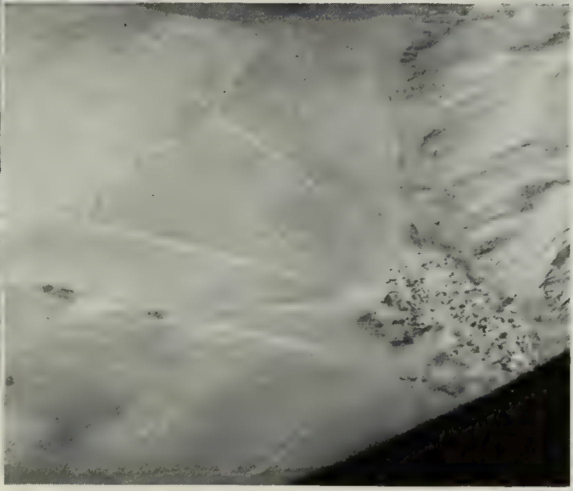
The success or failure of your survival experience will depend a great deal on how well you maintain your physical and mental efficiency. Both depend on adequate rest and water in the desert. Survival accounts analyzed by Dr. Richard A. Howard in the ADTIC publication, *Sun, Sand and Survival*, are full of cases where the men wore themselves out by midday travel. One group was located by the search plane and supplies were dropped. They kept walking and were never heard from again. Were they too stupid to rest and wait for the plane to return? Had dehydration clouded their judgment? We'll never know, but others who walked in the cool of evening or morning and holed up in caves during the heat lived out their story to happy ending.

Several accounts show that the weaker men of a party survived when the strong, husky boys were lost. The weaker men stayed behind and rested. When they moved, they followed the desert law and lived in slow motion like the Arabs and the camel. The stronger ones kept going until they became delirious and collapsed.

This brings us back to your body need of water and the danger of collapse from dehydration. It is true that your body is over 90 per cent water but it is all needed for the efficient operation of that body.

Dehydration is the loss of body water. It begins soon after your last intake of water, tea, coffee, soft drinks, soup, or other non-alcoholic liquid. In fact, most people tend to dehydrate between meals and replace their water loss when they eat. Such voluntary dehydration works without

A pool of water may last many weeks in a sheltered, natural drainage basin.



Above, trails lead to water in the desert. Know the trail patterns in your area.

Many desert wells have no superstructure, but trails often lead to water.

serious danger in temperate climates. When high temperatures, heavy work, or both push your cooling system into high gear, your sweat glands work at full capacity and your body water gets used up pretty fast.

The blood is first to lose water. That thickens it and throws a heavier load on your heart. Your circulation slows down. All of that tired feeling isn't because you've been working so hard. Part of it is dehydration. Notice how soon you feel rested after a good drink of water! If you had a glass of water about every hour or as often as you got a little thirsty, that tired feeling wouldn't mount up so fast. Keep the unnecessary load off your circulation and you will be more efficient at your work. A loss of only 2½ per cent of your body weight by dehydration will lower your efficiency 25 per cent.

Few people realize that the tired, vague feeling of discomfort signals the beginning of dehydration. They may not even be thirsty, for the sensation of thirst is easily suppressed. Like altitude hypoxia, dehydration sneaks up on you.

Those who have died of dehydration and left accounts of their experience indicate that there is no agony in dying of thirst. Thirst is merely a red light, a warning signal that dehydration is beginning, and you had better do something about it. You can stop thirst in many ways, from will power to pebbles in your mouth. You may put out the red light, but that doesn't put out the fire of thirst.

Thirst is the earliest symptom of dehydration. It disappears or is overshadowed by many stronger sensations as dehydration progresses. The sneaky way dehydration can hit you is well illustrated by the experience of three men who wrecked their jeep in the desert near the Persian Gulf. Search planes found them the fourth day. They had lasted about two days. The radiator of their jeep was still full of water—water which would have kept them alive until the plane found them! It seems reasonable to suppose that if there had been any "agony of thirst" or clear-headed thinking of their problem, the radiator would have been drained. There was nothing about the positions of their bodies to indicate exceptional discomfort. One was still sitting against a front wheel, one was lying under the car. The third had walked out some distance, wandered in a big circle, and collapsed when his tracks crossed his out-going route.

The two Arabs who suffered fatal dehydration in Saudi Arabia in 1950 likewise showed no violent ending. One wrote out his will after his companion had died.

My own experience is that desperate thirst is a very early symptom of rapid dehydration. Climbing out of Rosebud Canyon in southern Utah twenty years ago, I ran out of water but continued to push on at top speed. At that time I didn't know enough to take it easy. By the time I reached the top I was hot, sweaty, and panic-thirsty. My tongue had not started to swell, nor had any other dehydration symptoms except fatigue become apparent. It was still two miles to water but I was so worried that I tried to run. A local shower had left a few tablespoons full of water in rocky depressions. I lapped up those like a thirsty dog. The cool water was not enough to halt my dehydration but it did quench my thirst, quiet my panic, and give me sense enough to walk leisurely the two miles to water. The experience taught me how easy it is to quench thirst, and that thirst is not the killer. If you drink enough only to stop thirst you can still die of dehydration. Men have collapsed with water in their canteens. Don't confuse mere thirst with the serious condition of dehydration.

A good drink of water will do as much as anything you can do to reduce the shock, mental and physical, of finding yourself in a survival situation. Drink normally as often as you feel thirsty. That way you will stay in shape long enough to get well organized, to arrange your rescue signals, to find a shelter or build one from your parachute, and to attend to all the other details your survival manuals teach.

In the desert, where there is water there is life. Your total survival time depends on your water, the temperature of the air around you, and the amount of labor you do. *It makes no difference in your total survival time whether you drink your water first or last.* The real danger lies in your progressive loss of good judgment, loss of mental efficiency, and lowered physical capacity, all of which follow dehydration as surely as night follows each day.

Ration your sweat not your water! That is the best way to get the maximum value from your water supply. To ration your sweat you simply keep the heat load on your body at a minimum. That means resting in the shade during the heat of the day. Keep your shirt on. Keep your body covered so as not to waste your sweat. It may feel nice to let the wind blow on your bare skin but it takes more water from your body. Operate in slow motion. Travel in the cool of early morning or at night if visibility is satisfactory. Keep your water in the shade and don't spill it.

Near the seacoast you can stretch your water supply by dipping your clothes in the sea and wearing them damp. The evaporation of water in your clothes will give you the same cooling service as sweat evaporating on your skin.

Don't drink the sea water! Your body must have water to eliminate waste through your kidneys. Sea water contains a higher percent of waste than urine. Your kidneys will have to draw off additional water from your body to eliminate waste.

**Water is life in the desert. Look for vegetation and trees when downed.**

If your supply of water is running low and you decide to look for more, remember that in the desert, trails lead to water. Wells, waterholes and oases are reached by trails. Trails are visible from the air. They are marked on maps. Watch for them on your flights. If you have any control of your landing, try to make it on a trail. Wells are located at varying distances along caravan trails. Fifteen or twenty miles between water points is common in most deserts. However, in some bleak areas and on desert motor roads it is sometimes forty miles and even a hundred miles between wells.

You'll need the shroud lines of your parachute to reach water because desert people carry their own ropes. They don't leave them at wells. Desert water tables vary in depth from fifteen to a hundred feet. In some wells the water is more or less alkali and may even have a laxative effect on you. Even that is better than no water at all. Where there are no wells, it is possible to find natural cisterns and even small ponds after a rare heavy rain. I have seen ponds four or five feet deep in locations where there had been no water for twenty years. If there has been one of those rare rains in your area, look for a natural drainage basin. In mountainous regions water collects in caves or basins under tumbled rocks. Water in such deep shade may last many months after the rain.

In dry stream beds which form the desert drainage system when it does rain, the water may sink into the soil within hours after a storm. Standing pools may remain under overhanging banks on the outside curves of the stream. Frequently, natives cover such pools with brush in semi-desert regions.

In dune areas along the seacoast fresh water can sometimes be found by digging in the hollow behind the first dune. Also near the coast there is sometimes enough moisture in the air to form dew in the early morning. It can be collected on the wings of your plane. I have seen it drip from the eaves at Wheelus Air Force Base. Over on the Persian Gulf the moisture extends inland from 50 to 100 miles. The ancient inhabitants of Negev apparently used the dew to aid their agriculture by placing stones around the grape vines to collect condensation. Such condensation in desert regions disappears soon after sunup, so you had better mop the moisture from your plane with a clean rag and squeeze the water into your canteen before dawn.

I have lived and traveled in deserts for days, weeks and months at a time but always on my terms, not on the desert's terms. I have always planned in advance for possible and probable emergencies. I've carried my shelter, sleeping bag, and supply of food and water. I've learned in advance where wells or waterholes could be expected and I have kept my friends posted on the area in which I was working.

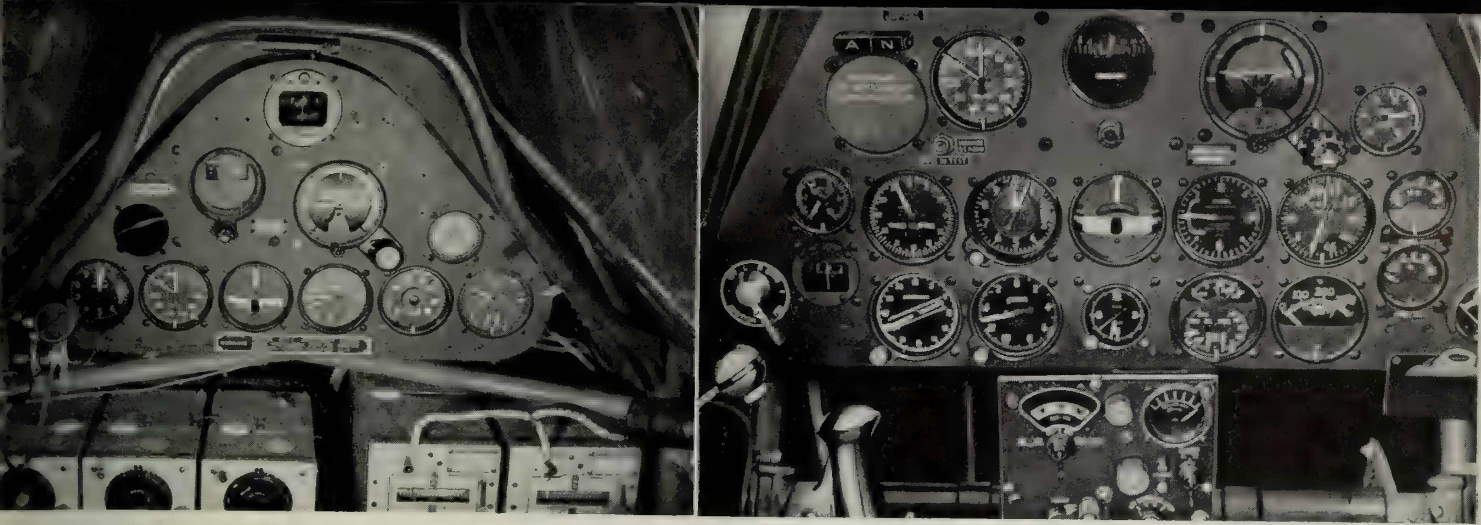
You can do the same. As long as your radio works you can keep the base informed of your location. You can see that your water supply is in the plane in non-leaking containers when you take off. You can check your survival kit, and learn how to use the things it contains. You can learn to operate your survival kit signal mirror and emergency radio equipment. You can study the maps of deserts over which you may fly and learn the few landscape features, find out whether the dry river beds lead to the sea, or lead deeper into the desert (as they do on the north edge of the Sahara in Libya).

You can study AFM 64-5, Survival and ADTIC publication D100, *Afoot In the Desert* to learn details about what to do in the desert IF and WHEN. Intelligent advance planning on your part can turn your desert emergency into a mere forced landing from which Air Rescue Service will pick you up in good health.

Don't sell the desert short. It is a rugged region but a fascinating one if you are prepared. ●

*Mr. Alonzo W. Pond is currently head of the Desert Station Section of the Arctic, Desert, Tropic Information Center. He is an authority on desert areas gained through some 20 years experience in the deserts of Africa, Middle East, Mongolia, and Mexico.*

*Mr. Pond is the author of numerous books and articles on the Sahara and Gobi deserts.*



New equipment affects all aircraft. The rear cockpit of the T-6D, left, lacks the instrumentation of the T-6G, at right.

# Complicated Safety

## An airplane that is awfully simple may be simply awful for safety factors

By William I. Stieglitz, Republic Aviation Corp.

THE equipment needed for instrument flying and long range navigation is mechanically complex, yet has increased the safety of flying, and has also extended the usefulness of the airplane.

Similarly, the equipment necessary for ILAS approach has added mechanical complexity, yet how many pilots would be willing to remove this equipment and go back to making circling approaches under an overcast? How many would go back to flying a DC-3 over the Rocky Mountains, as compared to flying a pressure-cabin airplane; yet cabin pressurization adds to the complexity of the airplane.

Each such increase in complexity, which in turn has extended the utility and increased the safety and the comfort of the modern airplane, has involved the installation of additional instruments and controls, making the pilot's problem more complex. At the same time, the increase in the speed of aircraft has, in many circumstances, reduced the amount of time available to the pilot to perform any given function.

The airplane is one part of a man-machine combination. Therefore, the important question is not whether the machine is complex in itself, but whether the man-machine combination can function efficiently.

We have not gained in over-all simplicity if, by extreme simplification of the machine, we complicate the situation for the human operator to such a point that we approach or exceed his basic limitations. It is often necessary to complicate the machine to simplify the pilot's task.

When a pilot must go through a complicated sequence of control manipulations to perform a comparatively simple function, it will usually be found that the mechanics of the system are too simple; that had the system itself been made more complicated, its operation by a single control might have been possible.

An illustration can be found in the emergency landing gear extension system of early jet airplanes. The main landing gear, in this case, will drop by gravity, and drag prevents its dropping to locked position. Since a hand pump was needed for ground servicing of the hydraulic system, and for operating other units in an emergency, the simplest way of providing for emergency extension of the nose gear was to use this pump, drawing from the emergency hydraulic supply. In order to reduce the amount of pumping required, a selector valve was added to isolate the nose gear system from the rest of the hydraulic system.

To achieve emergency extension of the landing gear with this system, it was necessary for the pilot to place the landing gear selector handle in down position, and then pull the emergency up-lock release. Following this, the selector valve was placed in "Nose Wheel" position, and the pilot pumped the nose gear down.

After this was accomplished, if the pilot wanted to lower the flaps the selector valve had to be returned to its normal position, the landing gear handle returned to neutral, the flap handle placed down, and the hand pump used to extend the flaps. It might be pointed out that nose gear extension took eight to ten strokes.

One manufacturer further simplified a similar system by eliminating the hydraulic selector valve. The result of this simplification was that ten times as many strokes were required to lock the nose gear down.

It is rather obvious that the procedure described above was time-consuming. As a result, pilots experiencing engine failure at low altitude often did not have time to get the nose gear locked down before touch-down, and the gear collapsed on landing. On the other hand, pilots who had sufficient altitude tended to extend the gear early. With a dead engine, the resulting additional drag of the gear often caused the pilot to undershoot. Besides these two conditions, an error was frequently made in one step or another of the complicated sequence of operations.

This situation was corrected by complicating the airplane. An emergency pneumatic system was installed in such a manner that pulling the emergency gear handle operated the necessary valves and discharged a high-pressure air bottle into the nose gear extension cylinder. In the later aircraft incorporating this system, the pilot need only place the landing gear selector handle in down position and pull the emergency up-lock release. All three elements of the gear extend and lock in a few seconds.

It is true that, in incorporating this pneumatic system, complexity and weight were added to the airplane; the system was made more complex, *yet the over-all result was simplicity.*

The dimming of cockpit warning lights affords a further example of mechanical simplicity which produced control complexity and loss of safety. The need for dimming such lights is obvious, since lights which are bright enough to be seen in the daytime are too bright at night. The standard method of providing control, up to the present time, has been by individual hoods on the lights.

There have been many instances of pilots failing to make sure that all warning lights were full bright, prior to takeoff in the daytime. Accidents have resulted because the pilot subsequently failed to see a dimmed warning light.

Accidents of this kind will be prevented by the added complication of a master dimming switch, such as has recently been adopted as standard by the Armed Forces. With this system, all warning lights are full bright when the cockpit lights are off, and are dimmed automatically to the proper level for night flying when the cockpit lights are turned on. An override switch is provided which permits the pilot to turn the warning lights back to bright, when he is using cockpit lights in the daytime to relieve sky glare. The override switch is automatically reset when the cockpit light switch is turned off. The complexities of such a system are apparent; so also are the increased safety, and the control simplification.

## Automatic Controls

Automatic systems represent even greater complexity aimed at simplifying the pilot's task. Many pilots object to automatic controls because of experience with systems which were subject to malfunction, and left them without adequate control, or without sufficient warning to permit them to assume control. Nevertheless, in many cases the answer is not to be found in throwing out automatic control systems, and thus imposing an excessive burden on the human operator. Instead, the automatic system should be made as reliable as possible, and should incorporate adequate warning devices. Further, provision for mechanical override is imperative, if functioning of the system is essential to safety. Such systems must be so designed that their operation is as simple as possible, they are easily maintained, and, insofar as is possible, they "fail safe."

An example of the use of an automatic system to simplify the pilot's task, and to eliminate a recurrent "pilot error," is found in the fuel systems of most modern fighter aircraft. In the conventional fighter of World War II, fuel systems consisted of numerous individual tanks, with manual selection. Errors in the use of this type of system were common. Pilots would switch to an already empty tank instead of a full one, leave the selector in an intermediate position, or, at times, allow a tank to run dry before switching.

**Mechanically complex equipment needed for instrument flying and long range navigation has increased the safety factors and utilization of new aircraft.**

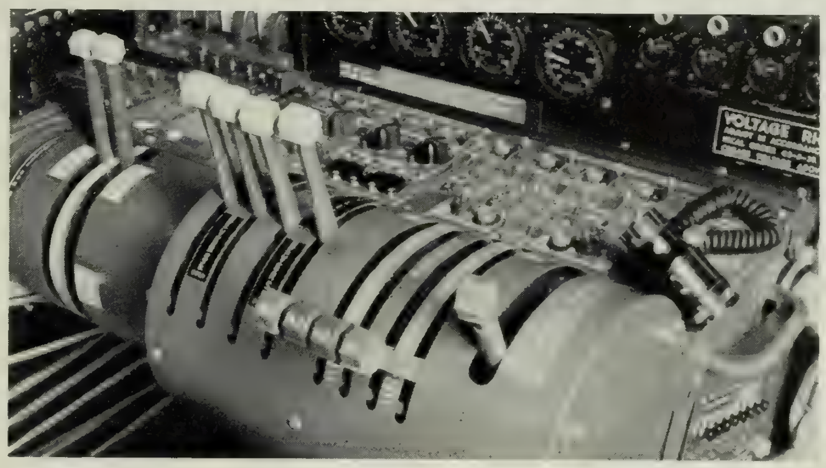
To eliminate the possibility of such errors, the fuel systems of present-day fighters are designed so that fuel to the engine is fed from a single main tank, and the fuel from all other tanks transfers automatically to the main. With such a system, the fuel selector is turned to an all-on position, and, barring an emergency or malfunction, the pilot need never touch it again.

This system is obviously more complex than the old type. Transfer pumps, fuel level control valves, and shut-off valves are needed. Provision is also needed to permit transfer of fuel to the engine directly from tanks other than the main, in case of a malfunction. It is true that malfunctions of such systems have occurred. Fuel level control valves, particularly in the early days of their development, were a persistent source of trouble. Accidents have resulted from malfunctions of this system, yet they are fewer in number than those which occurred with the old manual system. Here again, mechanical complexity has simplified the pilot's task, and eliminated a known major cause of accidents.

It has been argued that a duplicate emergency system is a needless complexity; that the primary system should be so reliable that duplication is unnecessary. Obviously, this would be the ideal state, but would imply a state of perfection not yet attained by man. Even though every effort must be made, and is being made, to make primary systems reliable, the possibility of human error in design, fabrication and maintenance is always present. Absolute reliability in systems and components cannot be expected; failures can and will occur, despite our efforts to prevent them.

It is true that through long years of development some items of equipment have reached a point of reliability such that failures between regular overhaul periods are an extremely rare occurrence. Duplication of such items is obviously unnecessary. On the other hand, there are many systems of which this is not true. For example, in a fluid-carrying system, with its fittings and flared tube ends, there is a definite possibility of failure as a result of faulty material, fabrication or maintenance.

In big aircraft a reduction of pilot's work load is necessary. Shown below is a B-50 engineer's stand.



In such cases, the consequences of failure must be carefully analyzed; if it will adversely affect the safety of the airplane or its occupants, a duplicate system for emergency operation must be provided.

There are many instances where this need is evident. The provision of an alternate power source for gyro instruments falls in this category, as the consequences of a loss of those instruments under adverse weather conditions would be disastrous. Primary flight controls involving hydraulic boost are in the same category. A failure of the primary system would mean loss of the airplane, and there can be no question as to the need for either a duplicate hydraulic system, or other means for the pilot to maintain control. To depend solely on the reliability of the primary system, no matter how carefully it is designed and maintained, would be totally unrealistic.

Most cases, unfortunately, are not as clear-cut as those discussed above, and these are the ones which become controversial. Here, a thorough analysis of all factors involved must be made, to determine whether a duplicate system is necessary, or would be merely needless complexity. For example, whether or not an emergency landing gear extension system is necessary depends on whether the necessity of making a belly landing, every time a failure of the primary system occurs, is acceptable. The consequences are the risk of injury to personnel, and possible total loss of the airplane, or, at best, the cost of major repairs and loss of use of the equipment. For a transport airplane, it is certain that the risk would not be acceptable to the public. For the military airplane, with the increased possibility of primary system failure as a result of combat damage, we cannot afford the cost, either economically or logistically. The increase in performance which would result from the amount of weight saved by omitting the emergency system is not worth the cost. Therefore, installation of an emergency extension system is required.

An analysis of all factors, such as outlined above, must be made of the need for any duplicate emergency system. If such an analysis indicates that an emergency system should be installed, every effort should be made to avoid needless complexity in the system itself.

The design of the system must be such that no single failure can make both primary and emergency systems inoperative. One point sometimes overlooked in this regard is the possibility of a failure of the emergency system inducing a failure of the primary system. Compliance with these principles often requires complexity.

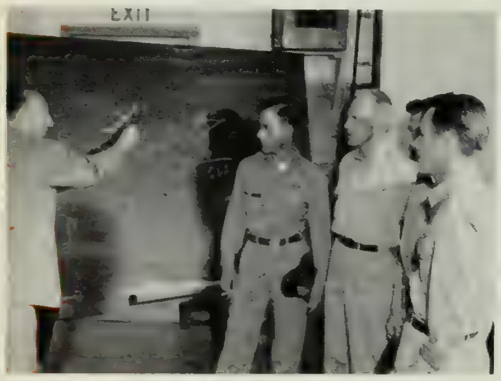
An emergency system, installed to safeguard against one type of failure, is of questionable value if a new hazard is introduced through possible malfunction of the emergency system itself. There have been cases where misuse of the emergency system has created such a condition. This does not necessarily dictate removal of the emergency system. Instead, an evaluation should be made of the relative severity of the hazard eliminated and that introduced, and the emergency system should be studied carefully to see whether, possibly by a slight increase in complexity, the secondary hazard cannot be eliminated.

Much of the complexity of the modern airplane is essential to its ability to serve its purpose, and cannot be eliminated without destroying that ability. We must, in fact, be ready to accept an increasing amount of complexity of this type, if aviation is to continue to develop. For example, the problem of mid-air collision is already pressing, and with the increasing speed of airplanes, will become acute in the very near future. With increased closing speeds, the range of human vision is insufficient to give the pilot adequate warning. Since we cannot change this human limitation, we must install additional equipment, such as collision warning radar. This is only one example of the added mechanical complexity which will be inevitable, unless we are ready to say there will be no further improvement in the airplane; that we are satisfied with its present utility, speed and safety. If we are not, we must be willing to accept complexity, and place the emphasis on reliability, rather than on simplicity of design. ●

# THE "D" IS DIFFERENT!

## USAF pilots are getting the latest word on the F-86D

**Pilots are lectured on the flight characteristics of the F-86D by team member.**



**A flight demonstration by Test Pilot Joe Lynch and question and answer periods dispelled rumors about the D.**

**Team members brief Maj. Gen. Victor E. Bertrandias, DIG, USAF, on F-86D flight performance. Left to right: Joe Lynch, Earl Hodder, Chuck Isande, Gen. V. E. Bertrandias, Dave Hoffman and Wes Wright.**

If you are one of the pilots who have flown the D model of North American Aviation's F-86 Sabre, it has already earned your respect. If you are in one of the squadrons scheduled to be operationally activated, your introduction to the all-weather interceptor version of the F-86 series is not far off. Additional training that means increased safety for you and your aircraft has been initiated by the manufacturer's instruction teams soon to visit USAF fighter bases.

Maybe you'll be one of the pilots to undergo transition training in this new Sabre and one who has never flown the other F-86 models. Regardless of your experience, you'll find this airplane different from anything you have ever taken off the ground.

The difference can add up to some interesting reactions on your part—reactions that influence your safety as a pilot and your performance of the assigned interception mission. The Air Force realizes this. So does the manufacturer of the airplane. You already know what the Air Defense Command and the Training Command are doing to familiarize you with this fighter. But the manufacturer, too, has assumed some responsibility for your introduction to the F-86D.

Let's say you've logged some twelve or fourteen hours in the D. You're sitting up there at 30,000 feet on top of 18,000 pounds of wires, vacuum tubes, automatic relays, solenoids, servos, and various black boxes you vaguely understand. You're moving along close to 700 miles per hour, conscious that you're flying the Air Force's fastest operational jet fighter.

Sure, you've read the pilot's handbook. You know the J-47-GE-17 engine kicks out with 5200 pounds thrust without its afterburner in operation. You know the general handling characteristics of the airplane. You know your endurance and your emergency procedures in general. And you know your own capabilities.

But what you don't know completely is this airplane. You know you've got to put it on what rumor calls a "collision course" and hold it there by interpretation of your radarscope signals. Without reference to anything *but* your 'scope you continue to within a few hundred yards of your target, taking your signal to breakaway not from your own judgment or experience but from what appears on your scope.

Brother, this is the time you need all the skill, confidence and assurance you can get!

The chances are that when you learned to fly, the term "electronics" was applied to radio only. Now, instead of the mechanical linkage you are familiar with, the only connection between your engine controls and the engine itself, (except for the emergency regulator) on the D, is an electronic control. And instead of relying on all that judgment you've built up as a fighter pilot you depend on your fire control system without a chance to even take a good look at your target.

The weakest link in this pilot-airplane-mission chain is you yourself. The airplane has been proven to the Air Force and it now has to be proven to *you*. To help with this introduction and to establish an attitude of safety and confidence the manufacturer is sending out trained teams to demonstrate the airplane. The teams talk with the pilots who are to fly the aircraft and answer any questions that arise at the bases to which the airplanes are assigned.

The manufacturer knows more about these F-86D's than anyone else so it's only natural he should pass this information on to you pilots, who will be flying them.

**The indoctrination course convinced pilots of the D's mission capability.**

This instruction is distinct from field service representative's activities which are concerned mainly with maintenance. The entire program is designed to give the information the pilot wants . . . and needs.

As the first models of the F-86D began undergoing accelerated service tests in 1952 at Wright-Patterson, Eglin, Edwards and Ladd, data on tactics, suitability, performance, stability, and cold-weather operations began to accumulate. Engineers were vitally interested in these tests and were in a good position to evaluate their over-all considerations.

A company team composed of project aerodynamicist Earl Hodder, engineering test pilot Joe Lynch, and Field Service project supervisor W. W. Wright sent up a trial balloon in the projected induction program at Tyndall AFB back in December, 1952. Reaction of the pilots who were conducting the test was immediate and emphatic: "Come back, stay a week . . . and tell us more!"

Subsequently, ADC made an official request in February, 1953, through AMC that the manufacturer's lectures become a part of transition training in the F-86D. In March the instruction team gave several of these indoctrination lectures at ADC headquarters in Colorado Springs for staff personnel and Maj. Gen. Frederic H. Smith, Jr., vice-commander of ADC. These lectures were repeated subsequently for the staffs of Maj. Gen. Morris Nelson, commander EADF, Stewart AFB, Maj. Gen. Delmar Spivey, commander CADF, Kansas City, and Maj. Gen. Walter E. Todd, commander WADF, Hamilton AFB.

Thus, complete agreement on the project was reached and approved by both the Air Force and the manufacturer's engineering department.

Typical of all these indoctrination lecture-demonstrations to come was the first one held at George AFB on 21 April 1953, for the 94th Fighter-Interceptor Squadron.

Pilots' experience in this squadron ranged from Lt. Robert Goodrich's 140 hours in other F-86 models to Capt. James Harvey's 550 hours A and E time plus 15 hours in the D. There was skeptical enthusiasim about the airplane, but a universal dislike for its all-weather purpose.

At a briefing preliminary to the flight demonstration, Earl Hodder presented slides on performance data, flight characteristics, and the use of the fire control system. Then engineering test pilot Joe Lynch took over, and using the same type of slides, discussed engine and flight controls and a few pilot inspection procedures, especially the seat pin and canopy lock.

Lynch also went into detail on best climb speeds, then talked about aerobatics and structural limits of the F-86D. Pilots were particularly interested in his statement of maximum attainable Mach in a full-power dive from over 45,000 feet, using afterburner. From his over 200 hours experience in the D, Lynch discussed the wing-roll characteristics at high speed, spin and stall characteristics, air starts, ejection seat details, and forced landing procedures.

Talk is all right, but the payoff came when Lynch took to the air for a demonstration of the F-86D's versatility. He used a maximum performance takeoff and followed it by a series of vertical rolls. He then went into vertical 8's, Cuban 8's, and immelmans to demonstrate control sensitivity . . . all below 10,000 feet. Most impressive to the pilots was the demonstration of slow flight just above stalling speed, followed by a go-around right on the deck, and his maximum performance landing. During this maneuver he showed the airplane can roll to a stop in less than 2,000 feet.

Pilots and crewmembers swarmed around the airplane immediately afterward. They inspected the landing gear and tires. They were amazed that such a short landing-run would not be damaging to the brakes or destroy the tread.

"Just routine," Lynch commented.

After the demonstration, Lynch remained with the pilots, answering questions and doing a little hangar flying. This, too, had a calculated effect on those who were scheduled to take off for their first flight in the D within an hour.

Comments of Major L. L. Arasmith, squadron operations officer, were typical of the pilots' reaction:

"A thing like this," he said, "really dispels rumors. We had been told unofficially a lot of things Lynch disproved. He showed us he's got confidence in the airplane and we should have, too."

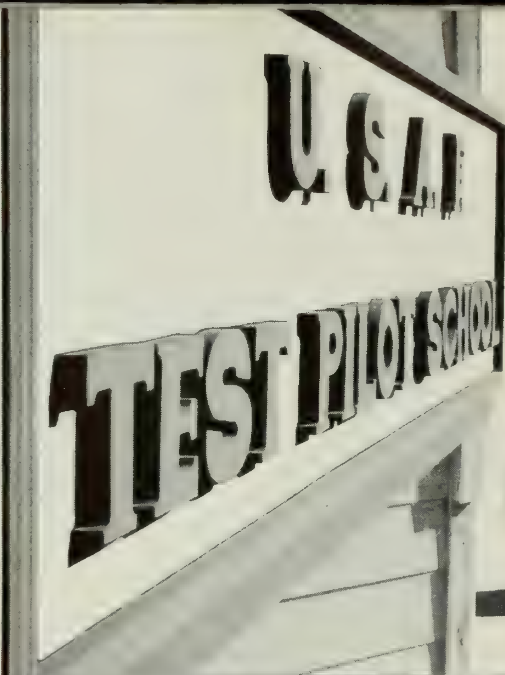
Maj. Carrol R. Northcutt, with eleven hours D time, stated:

"An indoctrination program such as this really cleans it up. It would take the boys hours in the air to gain the confidence they seem to have after this demonstration."

The manufacturer is now preparing a second indoctrination team to expedite this program. As rapidly as squadrons are activated for all-weather interception, one of these groups will conduct the same type of demonstration at each base to which the F-86D's are assigned.

So, when you're up there just a few seconds away from your target, eyes fixed on your radar scope, relax with the words of Captain Harvey after he witnessed North American Aviation's demonstration:

"In the F-86D, after what I've seen, I don't mind an all-weather mission. In this airplane, who would?" ●



The test pilot school at Edwards AFB is the only Air Force school of its type and one of five in the world.

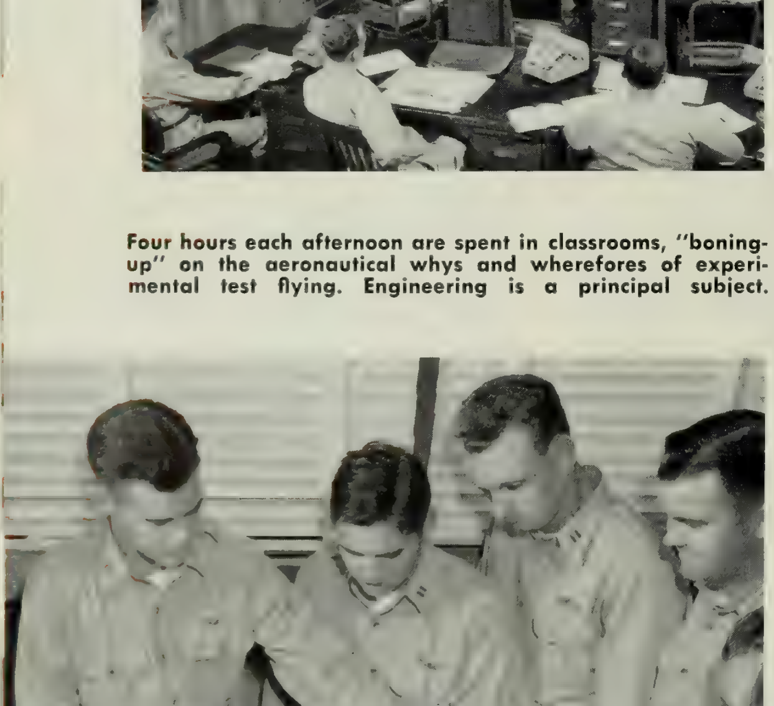
Four hours each afternoon are spent in classrooms, "boning-up" on the aeronautical whys and wherefores of experimental test flying. Engineering is a principal subject.

DURING the early morning hours high over the California desert, a pilot pulls back on the controls of a World War II B-25, putting the light bomber into a steep turn. A motion picture camera located behind the pilot records the aircraft's instrument readings while he brings the plane to accelerated stall. This is not the first time he or other pilots have performed this maneuver. It has been a required operation of a select group of pilots for the past ten years. These pilots are the students attending the U. S. Air Force's Experimental Flight Test Pilot School at Edwards AFB, California.

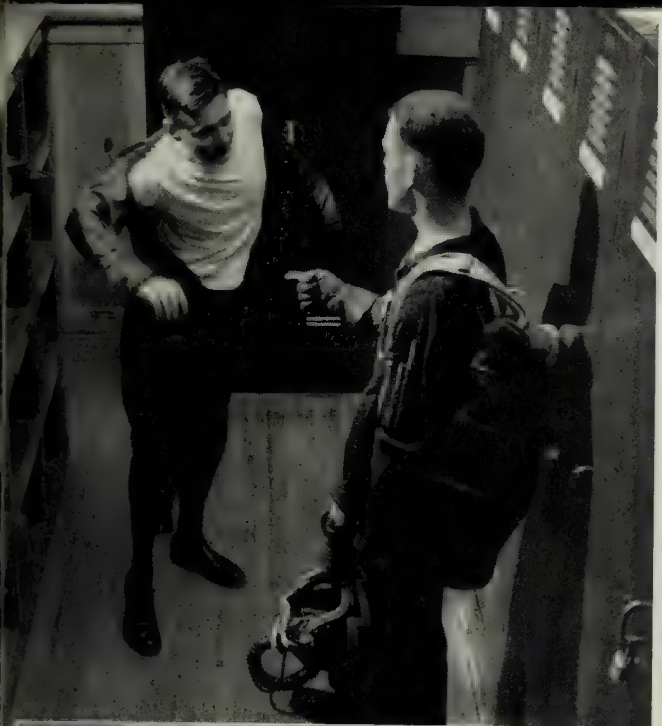
Approximately four hundred pilots have attended this school since 1943. There are four classes a year, one beginning each calendar quarter and continuing for six months. Each class is limited to 15 student pilots.

Entrance requirements for the school are high. An applicant is normally required to have the equivalent of two years of college engineering. A degree in engineering is highly desirable. He must have a minimum of 1500 hours of diversified flying time, and can be any rank from second lieutenant to major.

If a pilot has an exceptional record, it is possible that the other requirements may be waived by a board of officers. Air Force Regulation No. 53-19 authorizes any eligible officer to apply for training.



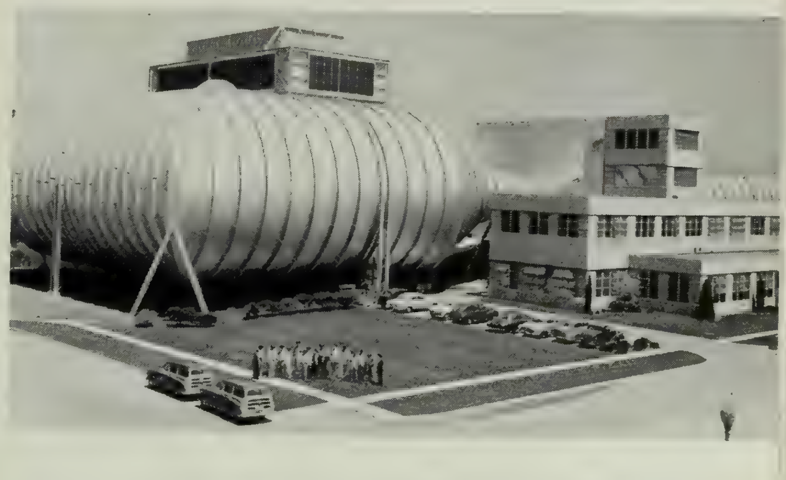
The old reliable "slip-stick" and a handy comptometer are necessities as the student absorbs flight test information.



From locker room to operations, instructors follow through with briefings before student makes test flight takeoff.

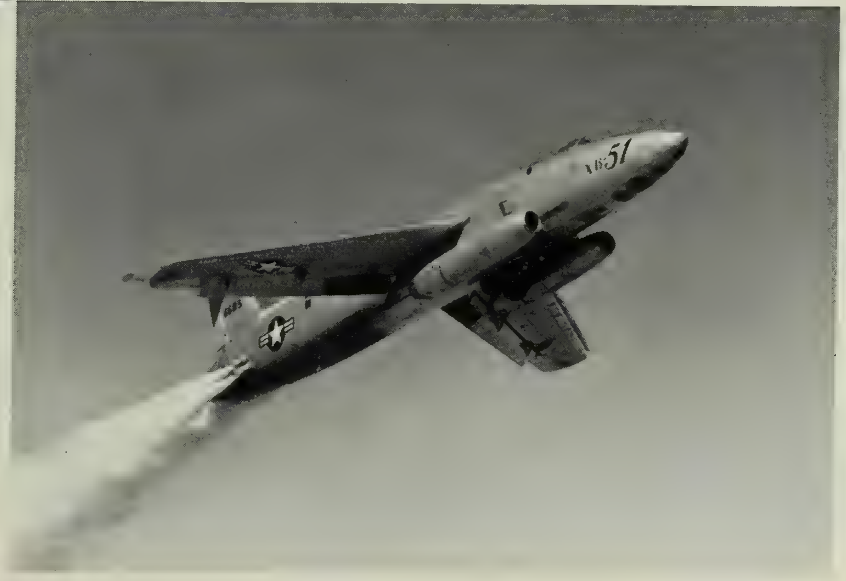
Experimental test flying is done on every type of airplane from the XB-52 to helicopters and liaison type planes.

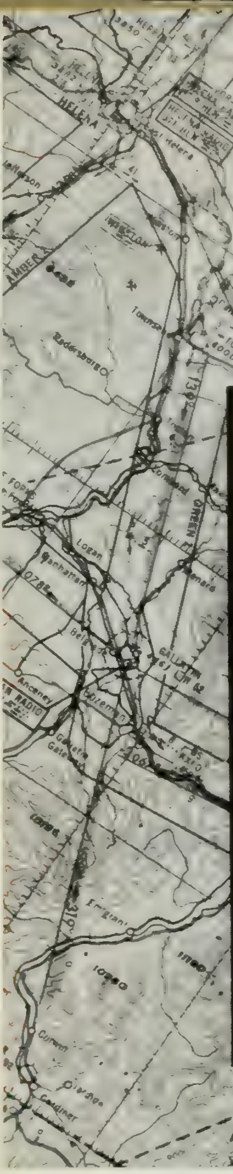
Students are taken on many tours of aircraft factories and research laboratories. Here, a test pilot class is visiting the NACA's Ames Aeronautical Laboratory, at Moffet Field, Calif.



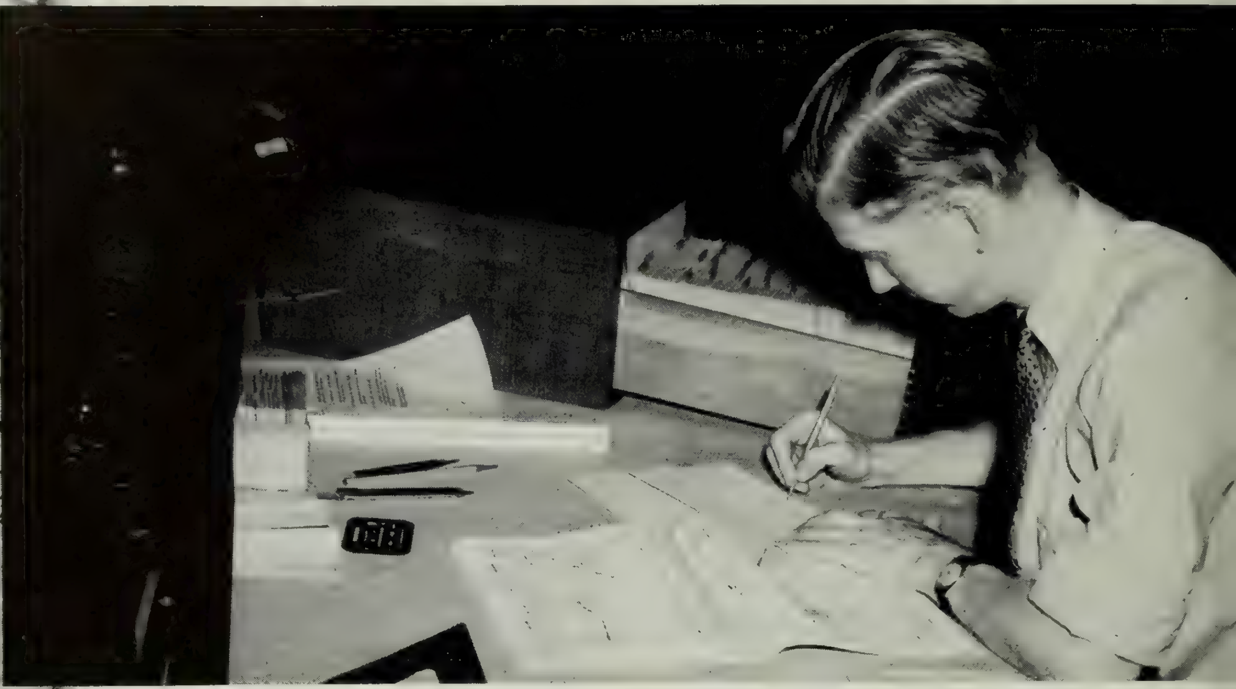
Students learn how to read and interpret film strips taken of instrument panel during a series of aircraft test stalls.

Pilots who have been graduated from the school fly all types of experimental planes. Below, the XB-51 on a test flight.





# THE CHARTS YOU CHOOSE



**Radio Facility Charts are kept up to date by expert technicians and fully edited each month.**

OLD P. T. Barnum always claimed that a sucker is born every minute, and sometimes in the flying business it looks as if the old boy rather understated the facts. There are considerable strange and wondrous tales which bear out this theory, involving pilots who would reach a high state of dudgeon if they were accused of being suckers.

None of these lads would think of purchasing shares in the Brooklyn Bridge or of buying some real estate located in the center of Lake Okeechobee. But when it comes to playing fast and loose with their lives, these boys don't give it a second thought.

When a pilot has an up-to-date source of information vital to the safety of his flight and chooses to ignore it, he can only qualify as a bonafide, grade A sucker.

Illustrating this premise is the case of the two fly boys who got lost on an instrument flight, at night, while milling around almost directly over destination. Reason? They didn't check available sources of information.

They had filed VFR and did all the navigating with a WAC chart. Finally, they got over an overcast a hundred miles or so from destination. Radio range frequencies and call letters were taken off the WAC instead of out of the Radio Facility Chart.

Unfortunately, the chart was over a year old and the call letters at the destination had been changed. The pilots were unable to get a proper identification but assumed that they were too far out to pick up the right range. Consequently, when they arrived in the vicinity of the station they were unable to orient themselves. Finally, an emergency was declared and they got a steer into the station. It was found that so much time had been spent in milling around trying to relocate themselves that they had insufficient fuel to proceed to an alternate. If the weather had socked in they would have had to abandon the aircraft.

In describing the incident both pilots emphasized that the flight chart contained erroneous information, but admitted they failed to check the facility chart containing the current information they needed.

An incident of this kind points up a lack of knowledge of the functions of the organization charged with getting this information to the field.

The Aeronautical Chart and Information Center (ACIC) is charged with providing the Air Force with aeronautical charts, air target materials, aeronautical information publications and documents, evaluated intelligence on air facilities, maps, terrain models and related cartographic services. ACIC is part of the

Air Photographic and Charting Service (APCS) under MATS command.

APCS has the dual function of supplying photographic coverage and charting service for the Air Force. It provides the Air Force with all special mission photography beyond the capabilities of standard reconnaissance units.

The Lookout Mountain laboratory is responsible for all photographic documentation of the Atomic Energy Commission testing program. APCS produces or procures all documentary films, training films and film strips required by the Air Force. APCS trains and provides combat camera teams and provides processing and editorial services for these units. It maintains film storage and film libraries for millions of feet of Air Force film.

The Air Force's first television unit, the 1354th Video Production Squadron, is also a part of APCS. This medium is proving of immense value already in the fields of training and documentation.

APCS photographic units include two squadrons based in the United States, and flights based in Japan, Alaska, Newfoundland, Panama, Germany, England and France.

The tremendous task of the charting service, handled by ACIC, can best be shown by a few statistics.

There are 7600 different kinds of charts and publications produced by ACIC. During the last fiscal year over 75,000,000 copies of these charts were produced, with over 67,000,000 being distributed to the field. The printing plant in St. Louis, where these charts are produced and printed, employs 200 military and 2300 civilian technicians.

To get back to the two pilots who tried to use a standard flight chart to obtain current air information. ACIC people are constantly amazed that so many pilots do depend on overprint information from a flight chart that may be completely obsolete.

Brig. Gen. Edwin M. Day, Commanding General, APCS, emphasized, "Pilots must remember that when they use flight charts and maps some of the overprint information contained thereon may be obsolete. (Air overprint information is printed in red or blue on flight charts and lists range legs, frequencies, call letters, etc.) The Radio Facility Charts and the NOTAMS are accurate and contain current, up-to-date information which should be used for navigation.

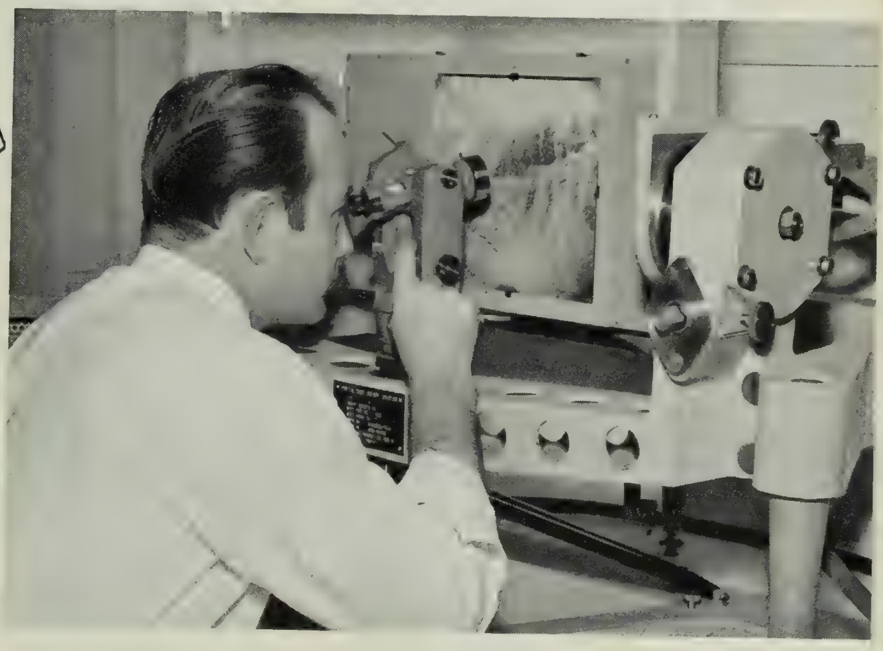
"A flight chart, such as one of the WAC series," Gen. Day continued, "may be over a year old and still be the current chart in use. It is impossible for the ACIC to keep these flight charts current in view of the tremendous day-to-day changes made in the material that constitutes the air overprint on these charts."

In this connection, the ACIC has recommended to the Air Force and HQ, USAF has concurred that all air overprint material that is subject to frequent change and short range obsolescence be omitted from flight charts. Then a pilot must check Radio Facility Charts and NOTAMS for this information.

ACIC personnel point out that the Air Information Division, which is responsible for Radio Facility Charts and Pilots Handbooks, receives an average of 1500 corrections, additions and deletions every week. Thirty to forty per cent of these changes are directly connected with safe flight as they concern routing and rerouting of airways, range frequencies and identifications, danger areas and instrument landing facilities. The other changes affect such things as airport facilities, lighting, servicing and condition of runways.

The ACIC maintains a world-wide network to obtain this vital information. In Washington, extensive staff and liaison offices coordinate a wealth of information obtained from cooperating Federal agencies.

**To produce a new chart requires 600 different operations. Here, mountain ranges are surveyed in matter of minutes with photo alidade.**



A committee composed of USAF, Navy, RAF and RCAF personnel assigns the responsibility for production of Pilot's Handbooks and Radio Facility Charts on a world-wide basis. This brings about standardization of procedures, graphic symbols and contents and enables the pilots of all three nations to use mutually the facility charts and handbooks without specialized training or briefing.

Both the U. S. VOR and LF facility charts are produced and distributed every two weeks, while the overseas editions are distributed once a month. Also, four RAF charts are used on a reciprocal basis. Domestic publications average 56,000 per issue, foreign editions total 7000 per month.

Specialists in the St. Louis plant estimate that 80 per cent of all the pages in the domestic facilities charts have at least one change every two weeks, while 98 per cent of all the pages in the domestic facility charts corrected every month.

Information is obtained from many varied sources and channeled into the chart information center. Results of both governmental and private surveying are received. Contact is maintained with local, state and national agencies controlling topographical changes and foreign survey organizations. Terrain sketches are obtained from missionaries and explorers and information is exchanged with domestic and foreign airline pilots. Navigation and information data are gathered from foreign aeronautical agencies.

All this information is channeled to research people who painstakingly check for accuracy and then use it to revise and correct current data appearing in the various charts in use.

Aeronautical Chart Information Offices (ACIO) also supply much of the information used by the ACIC in producing charts. These offices, located all over the world, act as gathering agencies for the ACIC and handle chart distribution for overseas bases. They are also responsible for contacting units for suggestions and recommended changes to current charts and publications.

Another function of the ACIO is to field test new charts and publications that affect their respective theatres. For example, each jet pilot in FEAF will receive one of the new jet handbooks for Japan and Korea.

These information offices are responsible for printing the Radio Facility Charts for their respective areas. In addition, NOTAMS are sent out to indicate special or hazardous conditions until the charts can be changed, using the same methods as the domestic NOTAM system.

They collect and verify much of this information from foreign military sources, air attaches, air liaison officers, foreign civil aviation authorities, airline pilots, private individuals and from the International Civil Aviation Organization (ICAO).

A better understanding of some of the problems of the entire ACIC operation could be obtained if all aircrew members could tour the gigantic St. Louis plant. There, hundreds of skilled technicians work at producing the most accurate charts and flight publications in the world.

ACIC figures that on a requirement for a new flight chart, as requested by a major command, it will take 18 months to produce and get to the field, unless it has top priority.

First, all possible sources of information are probed. When the information has been compiled, it is researched for accuracy and edited. It then goes through such varied phases as drafting, re-editing, art work, camera reproduction, printing, overprinting, final editing and distribution. There are approximately 600 separate steps from the original request to final distribution to the field.

The ACIC people have several pet peeves which they feel can be alleviated by a better understanding of their work.

One angle not considered by some supervisory personnel is that a tremendous amount of time, energy and money goes into producing Radio Facility Charts, NOTAMS and special NOTAMS, and in rushing this information to the base operations offices. If this information is not disseminated promptly and so efficiently that all pilots, both base and transient, are aware of it, the entire purpose is defeated.

**Three-D enters chart production when photo is checked with stereoscope.**

An example of this is the base where Radio Facility Charts are allowed to sit in a warehouse from several days to over a week before distribution—in the meantime pilots go on using old charts which may have obsolete or incorrect information in them. Other bases are guilty of not stressing the fact that pilots should *always* check NOTAMS, not only for destination but for route and bases along the course. This situation is particularly true of special NOTAMS that show new danger areas or temporarily unsafe conditions that might exist for a short time only.

To relieve this situation, General Day has personally recommended that a standard NOTAM set-up be established in the USAF on a worldwide basis. This would include a standard NOTAM board in each base operations as well as NOTAM files. At the present, some operations display special NOTAMS prominently and have operations people and AOs call attention to them, while others maintain a system that allows pilots to depart without being informed of pertinent information.

**Brig. Gen. Edwin M. Day, CG, APCS, stated, "It is the responsibility of each crewmember to send the ACIC information needed to keep charts current."**

Another peeve concerns the extremely wasteful usage of charts and handbooks. Every pilot has, at one time or another, drawn a set of charts for a trip and after landing left them in the aircraft or stuffed them in a navigation kit till crowded conditions demand that they be thrown away to make room for more of the same.

As a fix for this situation an interesting experiment is being conducted by the ACIC. They are now preparing plastic covered charts that can be written on, erased, and used again. A pilot can draw course lines with a grease pencil, rub them out at the end of the flight and have the equivalent of a brand new chart when it is needed again. These charts, which are being tested now by selected units, have the advantage of wearing much better than the old charts, even though used over and over again.

Even worse is the treatment of Pilot's Handbooks. Often they are not kept up to date, are thrown around the aircraft and generally torn up and mishandled. Pages are removed and not returned, so that the next pilot who needs some specific page finds himself out of luck. Some bases have a surplus and allow them to be stored, with no attempt to keep up the amendments. At the same time another base may have a critical shortage, but fails to order more until forced to do without.

However, the greatest criticism was directed toward the failure of most aircrewmen to report pertinent information to the ACIC through the proper authorities. All information is grist for the mill; whether it concerns a topographical change, a mistake in a chart or publication, or merely an added facility at an airport.

All the processes of the ACIC are contingent upon accurate, timely information. It is the responsibility of each aircrewman to send in this information. The ACIC believes that the best single source of the information they use should come from USAF crewmen since, compared with other sources, they cover such a tremendous amount of territory in a short time and are in a position to note all changes, both of the topographical and air information type, from a professional viewpoint.

This information can be reported rapidly in a number of ways. Military communications channels are available; base operations personnel can be informed or a phone call can be made. (See your Radio Facility Chart.)

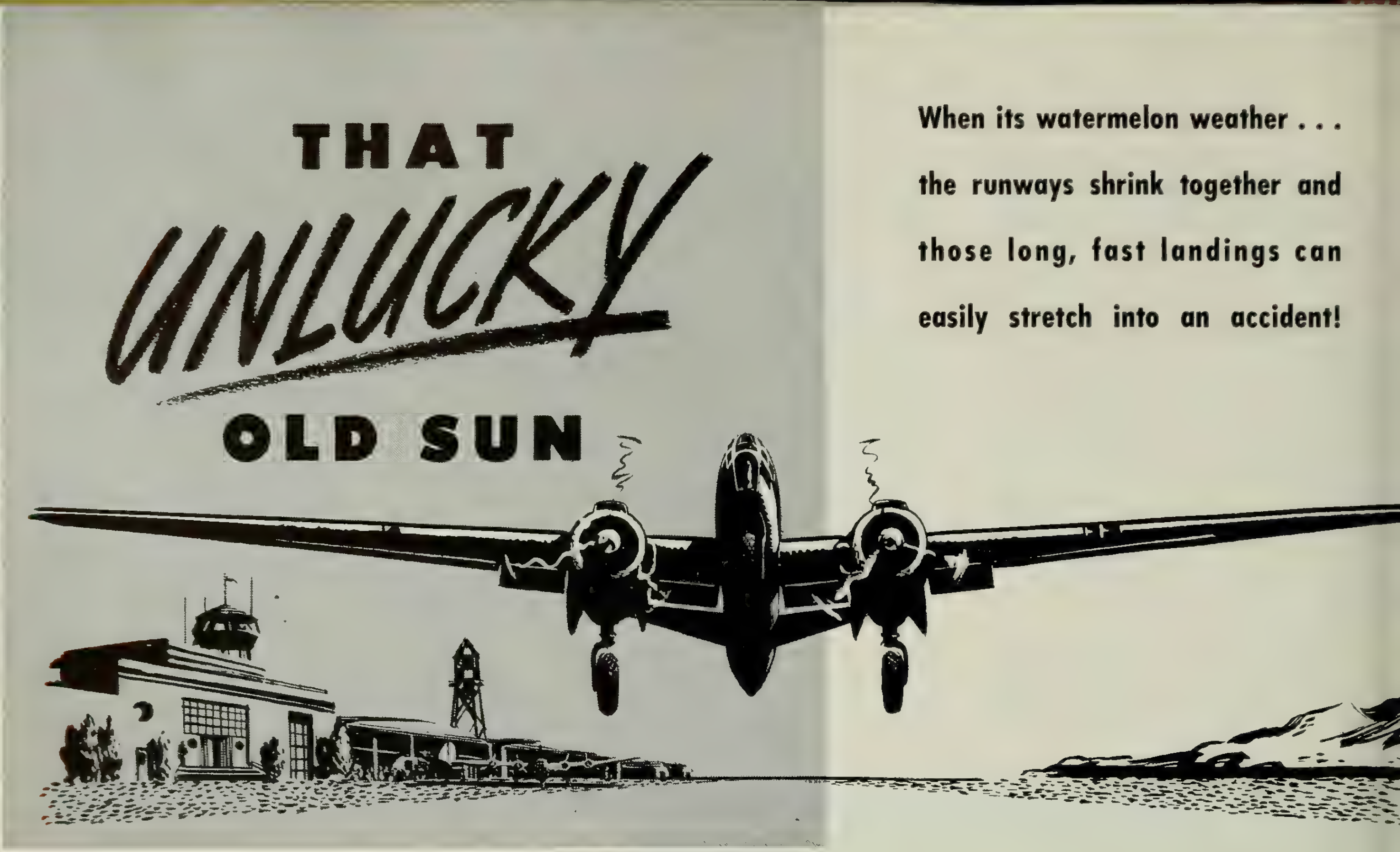
To make it easier for crewmen to report any changes, the ACIC will soon print franked, addressed, perforated postcards, attached to the Radio Facility Charts. Any information can be printed on the cards and dropped in the nearest mailbox. With this quick information system in effect, changes can be put out to the field more quickly than in the past. It is suggested that once the cards are in the charts, all base operations offices put a special mailbox in a prominent place to facilitate mailing.

Overseas a pilot can report this information to the nearest ACIO. Information offices are located at the following places: Westover AFB, Mass., Wiesbaden, Germany, Elmendorf AFB, Alaska, Tokyo, Japan, Hickam AFB, Hawaii, Albrook AFB, Canal Zone, Sealand AFB, Wales. If unable to contact one of these offices, be sure to give this information to the first base operations office possible.

Pilots can also give valuable information to the ACIOs on the Foreign Clearance Information Guide. All errors and changes in this book should be reported at once. The publication contains information on clearance requirements for landing or overflying any foreign country. It also lists specific theatre and country requirements for passports and visas, diplomatic clearance, immunization, aerodromes and routes to be used and availability of fuel service.

In emphasizing the importance attached to the information received from aircrews, General Day stated: "Hundreds of thousands of highly skilled man hours go into the detailed work of producing and maintaining our charts and publications. Each individual in the Air Photographic and Chart Service is personally aware of the responsibility placed on him by the Air Force. An aircraft without up to date navigational charts and aids is of little use in the defense of our nation. It is also the responsibility of each member of the United States Air Force to insure that we receive the latest, most up-to-date information with which to work." ●

# THAT UNLUCKY OLD SUN



**When its watermelon weather . . . the runways shrink together and those long, fast landings can easily stretch into an accident!**

HOT weather is here, and it's hard on man and beast, to say nothing of flying machines. With the advent of dog days, runways and tempers get shorter, airplanes and clothing get heavier, and the term "no sweat" becomes a mere figure of speech.

One of the problems of military flying today which continues to haunt the accident prevention program is the simple takeoff. This maneuver is one of the most basic concepts of flying, yet it imposes one of the heaviest factors in planning.

Runways have been continually lengthened until some of our modern airdromes resemble the Pennsylvania Turnpike, yet contrary to popular opinion, the extension of a runway does not provide the panacea for takeoff accidents. Particularly during periods of hot weather.

The prime reason for the trend toward longer runways is the need for higher speeds, longer range and heavier payloads.

In order to get range and payload, gross weights have gone up. This, also, requires longer takeoff runs.

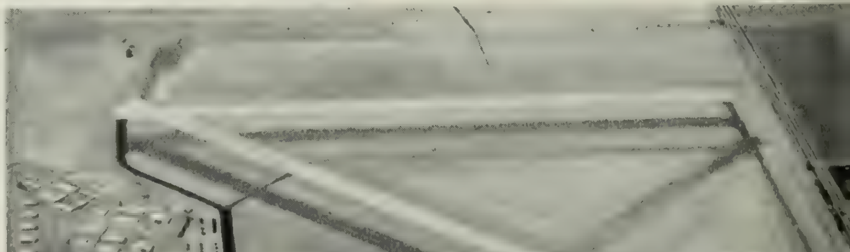
The problem is further complicated by the varying characteristics of individual airplanes, types of missions, variations in seasonal temperatures, and field elevations. The advent of the jet airplane did not simplify the problem . . . in fact, it added to installation headaches.

Because the thrust of a jet engine is directly related to air density, it is essential that both temperatures and field elevation be considered when planning for takeoff runs and aircraft loadings.

In checking a directory of military airfields, both in the ZI and abroad, it has been noted that the great majority of runways are at elevations of 1500 feet or less, MSL. So it is obvious that temperature would be the most common factor that would affect the air density at most airfields.

The one thing that no pilot can afford to become is a "creature of habit." "Habit" and mechanical procedures rate high among "killer" items. So, keep in mind that even though the gross weight, the pilot, and the aircraft remain the same, takeoff runs vary in direct proportion to the runway temperature and the heat of the air.

**In addition to the many obvious problems encountered while flying in the summertime, the pilot has to watch out for heat-wave optical illusions.**



A pilot who is used to becoming airborne after a certain length of time or distance, may become inclined to abort his takeoff from a field that is high above sea level after he gives his machine the needle, and then rolls and rolls and rolls. His basic problem is that the air is hot and thin, and he just needs more time and distance to become unstuck.

A basic rule to remember is that in hot air, the indicated airspeed will be the same as at lower temperatures, but the ground speed will be faster because the air is thinner.

Here is a typical example of how altitude and temperature can gang up on a pilot, with grievous results:

A pilot in a T-33 was taking off from a field 4000 feet higher than the one at his home station. The temperature out on the field was 94°F., and there was a headwind of less than two knots. (Headwind is a *very* important factor.)

After using all of the 8000 feet of the runway, he finally pulled the airplane off and staggered into the air, only to settle again to the overrun a hundred feet off the end of the pavement. "Wham!" he hit, and "Woosh" into the air again, staggering aloft at 140 knots. Inasmuch as the terrain rose gradually from the end of the runway, the airplane skimmed the top of a hill, taking with it a handful of power-line wire.

This birdman was lucky. He walked with the angels, and managed to get back to the field without damage to himself, but with major damage to the airplane.

For a general rule-of-thumb estimate, you can figure that temperature rise figuratively lifts your field elevation. For instance, 100°F. at sea level is equivalent to 80°F. at 1000 feet; and to 60°F. at 2000 feet above sea level. This, in general terms, means that for a twenty-degree rise in runway temperature, you will need about 20 per cent longer takeoff roll.

Let's look at some actual figures just to give you an idea of how the runway contracts under a beating sun.

Our first example is the T-33. We'll take off with 230-gallon tiptanks and 15,500 pounds gross, at a field level of 1000 feet MSL. At 23°F. (—5°C.) you'll need only 2750 feet; at 59°F. (+15°C.) you'll need 3500 feet; at 95°F. (+35°C.) you'll need 4500 feet, and at 131°F. (+55°C.) you will have to roll for 5700 feet before you break ground.

With the F-84-C, with tips and 16,500 pounds gross, at 1000 feet MSL, you'll need 4200 feet at 40°F; at 60°F., you take 4800 feet roll; at 80°F., the roll increases to 5400 feet; at 100°F., you need 6000 feet, and at 120°F., not an uncommon runway temperature in the desert, your airplane will roll for 7100 feet before becoming airborne.

The F-86-E has takeoff roll characteristics similar to the T-33. With tiptanks and 16,400 pounds gross, at 23°F., you need only 2350 feet at 1000 feet elevation, but when the temperature rises to 95°F., the aircraft takes 3900 feet to get off.

From these figures it is clear that the runway length shrinks nearly to one-half the normal measurement with the advent of hot weather.

SAC pilots will tell you that a B-29, grossing 110,000 pounds (sea level, no wind) needs only 2800 feet of ground run on a standard day (59°F.). But at 75°F., an increase in temperature of only 16 degrees, this airplane needs 3100 feet to get off the ground with 25-degree wing flaps. Three hundred feet more doesn't seem like a great distance, but it can be the measure of disaster to the pilot who isn't savvy to the tricks that heat plays on airplanes.

This phenomenon is also the reason for closely checking takeoff weights. A slight error can result in very serious consequences.

We all know that higher ground temperatures are more critical in jet aircraft than they are with conventional airplanes. Jet pilots know that there are certain bases where no takeoff should be attempted when the thermometer is boiling, especially when the field altitude is higher than 2500 feet MSL with a no wind condition as an added hazard.

Not long ago two jet pilots tried to make a takeoff when the sun was beating down on a mountain air base. They consulted the Dash-One, all right, but for the wrong airplane type. One boy got off okay but the other crashed at the far end of the runway. If the second pilot had known the current takeoff distance, chances are he would not have tried to take off.

So much for pilots and takeoffs.

Another hot weather danger, and this danger is to the well being of

**Summertime brings shortened tempers, more important, "shortened" runways.**

the airplane itself, is careless ground operation, resulting in high oil and cylinder head temperatures. We all know that proper engine cooling means longer engine life, more efficiency, greater dependability, and of course a higher flight safety factor. This is the responsibility of the aircraft commander. Where engines are closely cowled so as to cool with minimum drag for speed and range, heat control is all important.

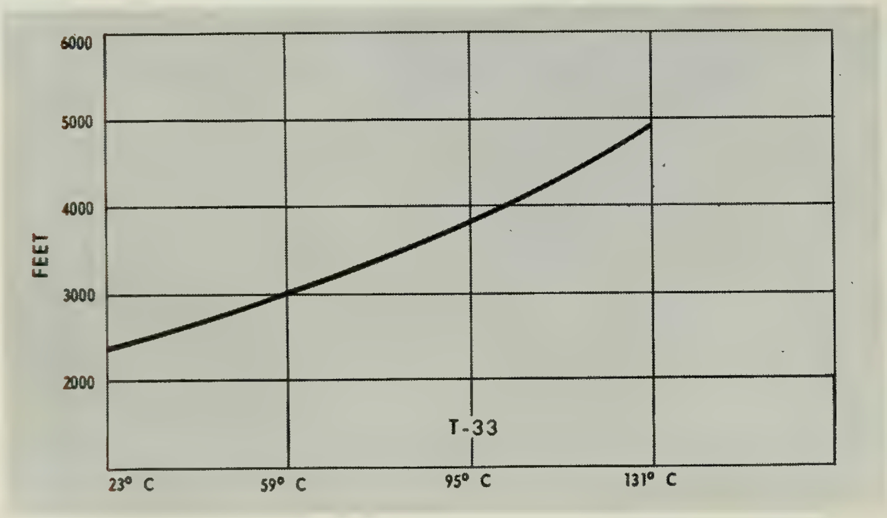
### Start Engines Quickly

Engines should be started as rapidly as possible . . . in four-engine airplanes, all four engines should be running three minutes after the starting procedure has been initiated on No. 1 engine. Cowl flaps should be full open for all ground operations.

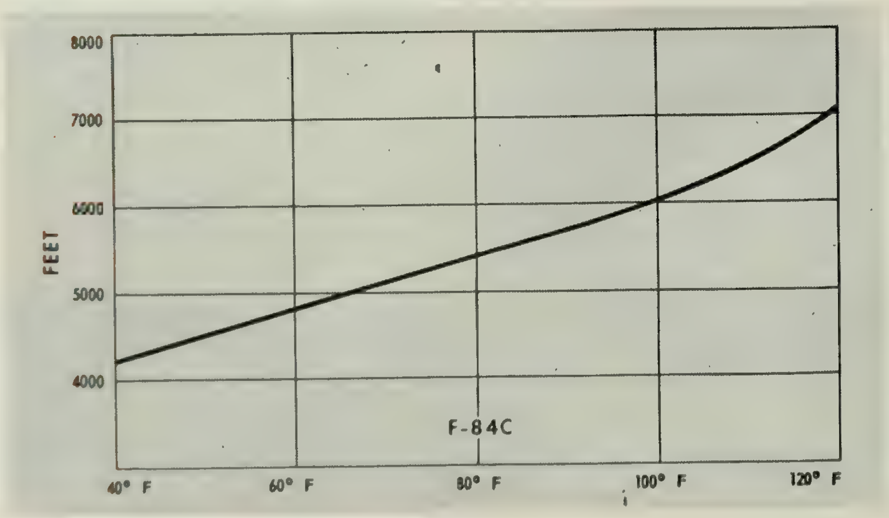
Another hot weather tip is to get off that dime and start rolling as soon as possible. Don't delay your taxiing operations, and remember that you'll generate less heat at low idling RPM's than you will with high idling speeds.

When you run your power check, be sure to head into the wind. Difference between "upwind" and "downwind" engine cooling is tremendous.

Reduced power takeoffs are not recommended in hot weather. Manufacturers have proved that engine temperatures upon becoming airborne will be the same with full takeoff power as with reduced power. Reduced power increases the takeoff time and the takeoff run, and engines will operate at high temperatures for a longer period. Also, reduced power takeoffs narrow the safety margin in the event of engine failure.



**Increased temperatures mean it'll take more distance to get off the ground. In general, a twenty-degree rise in runway temperature means you will need about twenty per cent longer takeoff roll. The chart above shows the temperature-length ratio for a T-33. F-84C, below.**



When you know that the runway surfaces are hot, and that the sun is popping the corn in the fields, plan your landing approaches accordingly. Don't come dragging it in over the wheat fields, low and slow. High power settings are required to maintain that slow drag, with gear and flaps down, which means that your engines are going to overheat.

Remember, that excessive cylinder head temperatures, in addition to shortening engine life, are one of the causes of detonation. Temperatures above the limits set forth for various power conditions tend to cause detonation. When serious detonation starts, internal cylinder temperatures immediately rise to a point where heads and pistons overheat and the valves burn and warp.

If your airplane has been closed up in the morning, when the air has been cool and damp, or during a shower, it should be unbuttoned as soon as possible to permit free air circulation. This prevents sweating, and lessens the chances of moisture or condensation damage. This is particularly true in parts of the world where humidity is high. One of the most damaging periods occurs when the sun comes out after a mid-day shower. A hot summer sun plays hob with plastics, such as the coverings used for electrical wires.

### Check Control Cables

Also, remember that control cables are usually rigged to tension under ideal temperature conditions. At *high* temperatures these cables may become slack, and your controls may become loose to a danger point. In summer, as in any other season, crew efficiency is directly tied to crew comfort. We can't always change the weather to please the flying people, but flying personnel can, in many ways, make it easier on themselves when temperatures soar.

Hot weather is rough on men and machines, and the operating efficiency of both means the difference between a low accident rate and a high one. Knowledge of hot weather operations is an important phase of the accident prevention program. ●

### ARS Personnel Often View the End Product of Pilot Error . . . They Believe That "It Just Ain't Necessary"

By Major W. F. Rubertus and Captain D. A. Bolls

PERHAPS more than others, members of the Air Rescue Service often have the unpleasant duty of viewing the end product of pilot and maintenance error — human misery and death. The memory of these incidents is not conducive to sound sleep and pleasant dreams—especially when we feel that "It just ain't necessary!"

After seeing a number of these ragedies, it becomes apparent that a re-education campaign is in order. While Air Rescue Service can hardly be expected to prevent in-flight emergencies, *it can frequently preclude their fatal termination.*

Many instances can be cited where pilots have failed to report their emergencies promptly, thus unnecessarily jeopardizing the lives of their crews. Since Air Rescue Service maintains a 24-hour vigil, the question becomes one of "WHY?"

After due consideration we con- lude that many pilots are either unaware of the rescue facilities avail- ble or consider their use as an admission of error. This is nothing but oolish pride and, we hope, can be vercome by appealing to their common sense and by informing them of what we have and how to use it.

Therefore, we become "Salesmen." We offer a product which we believe o well-equipped aircrew should be ithout. Devoid of fine print and war clauses, it consists of the material resources, ingenuity and willingness of our people, dedicated to the interest of *your* in-flight safety, and may be appropriately considered "Airways Insurance."

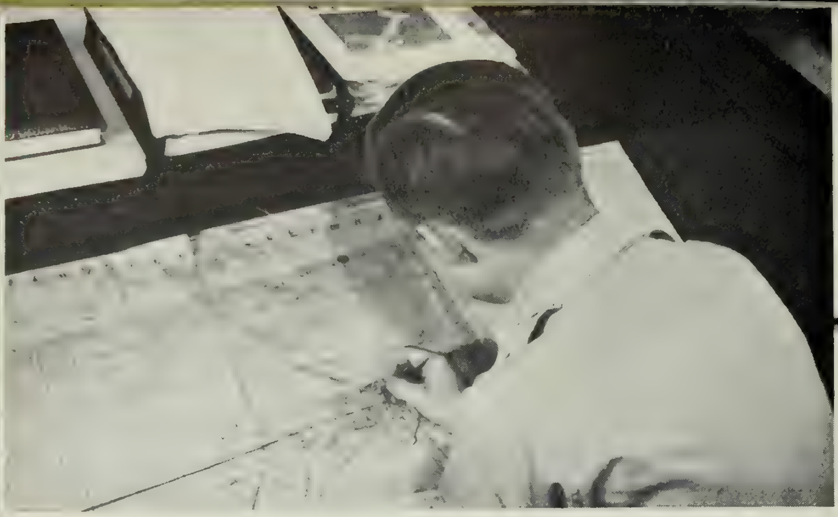
**Sales Resistance**

But we of Air Rescue Service are often surprised at the sales resistance we encounter. The fly-boy with a few hours of emergency-free flight is a difficult prospect, and, although appearing to listen carefully, his mind seems to be far away. He agrees that rescue is OK for the other fellow, but nothing could happen to him. "Don't I check the crate? Don't I get the weather? Don't I read the NOTAM's?" and on and on. Of course, he does! But one day here he is—belly up in the boon docks without enough gas to heat a can of emergency rations. Again, we ask "WHY?"

Over most of the airways that men fly, Air Rescue Service is as close as the mike button. Our crews are trouble shooters of the wild blue yonder and they are dedicated to the preservation of life and the prevention of human suffering. Yet, they receive the least cooperation from the very man who keeps them in business—the *indifferent* flyer.

Time is a factor in favor of a pilot if he uses it wisely. Precious minutes spent in sweating out a recalcitrant engine are sorely needed by ARS in getting an aircraft airborne and in position to help. There have been times (too many) when emergencies tend to grow—and some of us have seen the results—when we could find them! A distressed aircraft that can be located by radio and radar while airborne is much more preferable to a lot of little pieces that require an extended visual search to find.

Let's look at another type of "throttle jockey"—he knows all about Air Rescue Service and never fails to call them when some sort of emergency develops while in flight. But after the interception is accomplished and he is safely tucked under the wing of an SA-16 or SB-29, he becomes quite confident and decides that maybe he wasn't so bad off as he thought. This courageous fellow then blithely continues with his original mission, believing it is unnecessary to head for the nearest dry land or the closest airfield. He quickly forgets his feathered engine, and bad oil leak, or the rescue crew who must tag along after him and miss the rare roast beef the wife had fixed for dinner. He also forgets (or doesn't even think about) the Alert that's still on, back at Rescue's home base. The para-rescue team is ready, other search aircraft are standing by—*just in case*—and until he finally makes up his mind



**The position of a distressed aircraft is plotted accurately by a specialist on a master grid chart in the ARS Operations Center.**

**Minutes after a position report has been received crewmembers of a "dumbo" scramble for a take off.**

to set it down somewhere, they'll remain that way. In short, he's not very considerate of his airplane, the lives of his crew, or of anyone else.

We know that most USAF Commands have policies in this regard, but one statement is usually included in all of them, "The final decision rests with the aircraft commander." All too often, "I can make it" has become a crew's epitaph.

There is still another type of pilot with whom we come in contact. This is the reticent, quiet type, who, when an emergency develops, believes the Rescue aircraft can locate and intercept him by clairvoyance or some sort of divining rod. He usually has too much important business at hand to answer radio calls, and when he finally does decide to speak, he will give only the barest details.

It is in these cases that we have a definite requirement for a crystal ball. While we are equipped with the finest electronic DF equipment available and our crews know how to use it, we need the cooperation of the distressed aircraft in every case. If we get it, we can find 'em, escort 'em, and even talk 'em into a landing—but we *can't* do it alone.

We repeat, it's *you*, the pilot, who can do the most to help us find you quicker. On long flights over water, for instance, when the pilot of an approaching or departing aircraft fails to send in his hourly position report, ARS control alerts a rescue coordination center. Until the pilot of such an aircraft is contacted and conditions are *proved* to be normal, an ARS unit will remain on the alert.

If the non-reporting aircraft cannot be contacted within a reasonable length of time, an alert ARS plane is dispatched to intercept and escort the distressed plane to its destination or alternate. Again, pilots may ask for this aid before their emergency becomes critical.

At a Rescue Operations Center a master grid chart is kept up to the minute. The complete rescue operation is followed constantly on this grid chart and the exact locations of the rescue and distressed aircraft are kept pinpointed.

Now, if the aircraft having trouble is not located, the Rescue Coordina-

## Follow the Rules for Safety!

While the Air Rescue Service provides relief for all types of emergencies, whether it be an aircraft in trouble, or any other type of rescue action, it is primarily concerned with the most common emergency—that of the aircraft and its crew in distress. These emergencies take the form of feathered engines, lost aircraft, bail-out, and any other indications that may lead to trouble.

Each squadron has an area of responsibility and each is responsible for initiating the action on all aircraft emergencies within this area. If additional assistance is needed, it can be readily obtained from other Air Rescue squadrons, or its assisting agencies, such as the Civil Air Patrol, the Highway Patrol, and many other valuable sources. Each squadron has the necessary equipment and highly trained personnel to fulfill its mission. These people are available twenty-four hours a day, seven days a week, to lend a helping hand to anyone who may need it.

Listed here are some of the things which should determine just how good an insurance risk you are:

☆ Follow your proposed flight plan as closely as possible. Then, if you do get in trouble, you'll be easier to locate. Speed is of the essence in rescue work.

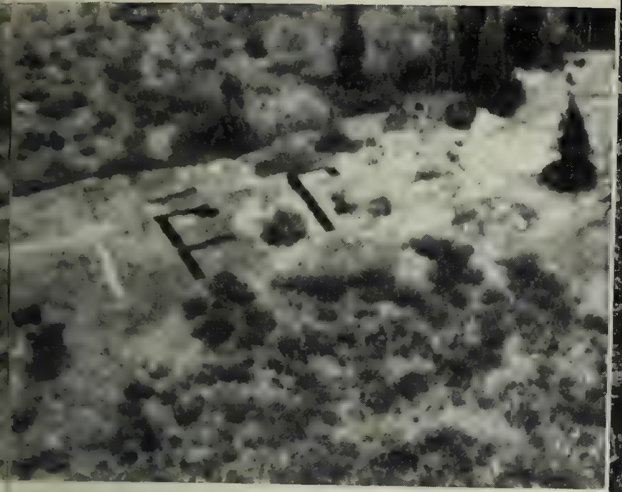
☆ At the first indication that serious trouble may be in the offing, don't be proud. Let someone know about it . . . anyone! Your family would rather have you around than a paid up insurance policy. So would the Air Force!

☆ Close that flight plan. Failure to do this has caused Air Rescue and its assisting agencies a lot of headaches and expense in locating an aircraft's whereabouts, not to mention the embarrassment to the individual concerned. Be especially cautious at installations where your flight plan has to be closed by means other than your presence.

☆ Make all required position reports. Let someone know your position, or where you have been, and where you are headed for. This will prove an invaluable aid if trouble should develop. Who wants to buy an airplane if you won't be around to fly it?

Just following a few simple rules will help insure your being able to fly another day and will aid the Air Rescue man to fulfill his code—"That Others May Live."

**—1st Lt. H. R. Ogden**



Signal panels enable Air Rescue units to determine actual requirements of crewmembers of distressed airplane, particularly when medical aid is needed.

tion Center goes into "all-out" operation. A mission commander is designated and he, with his assistants, carries out the rescue mission to a conclusion. The mission commander does not leave his desk and grid charts but controls the operations from the ARS Center.

The searching aircraft cover the water area where the pilot of the missing plane was last heard from. A systematic search continues until a patch of sea-marker dye is spotted—or the missing plane is located.

This information is then immediately relayed to the Mission Commander who pinpoints the location. f the pilot is down and in a raft, escue aircraft will drop its lifeboat.

The A-3 lifeboat, which the B-17 arries, can be dropped with much ccuracy and contains enough clothing, water, food and medical suplies for survival of nine men. Of ourse, the boat is equipped with two asoline engines, a mast for sailing nd many other features.

After the boat is dropped to owned crewmen, an ARS plane ands by to direct the survivors to he nearest land. The Mission Commander also alerts naval surface vesels of the location and heading of he survivors and these vessels co-perate in the rescue. If the pilot of distressed plane over water makes e decision to ditch, he may be near n ocean station, sometimes called weather patrol," manned by the Coast Guard. Besides being an information bureau, the ocean station is an aid for aircrews flying the oceans.

Ocean station vessels are manned, equipped and operated to provide search and rescue communications and air navigation and meteorological reporting services. Ocean weather observation station vessels will, upon request, pass radar fixes to aircraft within range. Fixes when obtained are passed to the aircraft in terms of bearing and distance in nautical miles from the vessel's grid position. A vessel's grid position is the center of an arbitrarily selected section of an ocean, 10 miles square. These ships operate radio beacons, as an aid to navigation. Strictly speaking, the Coast Guard ship is on station when it is within the 10-mile square and these station areas are spotted hundreds of miles apart in both the Atlantic and Pacific oceans. Their locations are shown in Radio Facility Charts for the appropriate areas.

The ocean station vessel normally is authorized to leave the station for only three reasons:

She may leave temporarily because of unusually severe weather conditions or damage by which her own existence is seriously endangered.

She, of course, goes off station when the relief weather ship arrives to take over the patrol.

But the best reason of all is when a ship or plane is in difficulty and the weather vessel is near enough to give help directly and promptly.

In summary, over water or land, when you know you are in trouble, get on the horn and give out with the most complete and accurate information possible to the rescue agencies . . . immediately. Don't wait. To carry out rescue operations effectively, your rescuers must know—

- ☆ What your trouble is—
- ☆ Where you are now—
- ☆ Where you are headed—
- ☆ What your direction is—
- ☆ What your altitude is—
- ☆ What your speed is—
- ☆ Where you plan to ditch or crash land.

If you leave out any of these whats, wheres and whys, then the ARS people have to start guessing. Send out as much as possible or all of the information and then continue to keep your rescuers informed.

You should know all of the communications facilities in your airplane in the event you get into trouble; know how to use it and know just what the equipment can do for you in any spot.

Remember, it's *your* Air Rescue Service, operated in the interest of *your* welfare. So, when in doubt, get on the horn, call 121.5, and make your reservation early. Help 'em all you can so that they can do right by you. Then you too can join the long, blue line of those who have said,

"Boy, am I glad to see you!" ●

**2d Lieut. Glenn C. Gunsallus**

**1st Lieut. Wallace N. Frazier**

# WELL DONE!

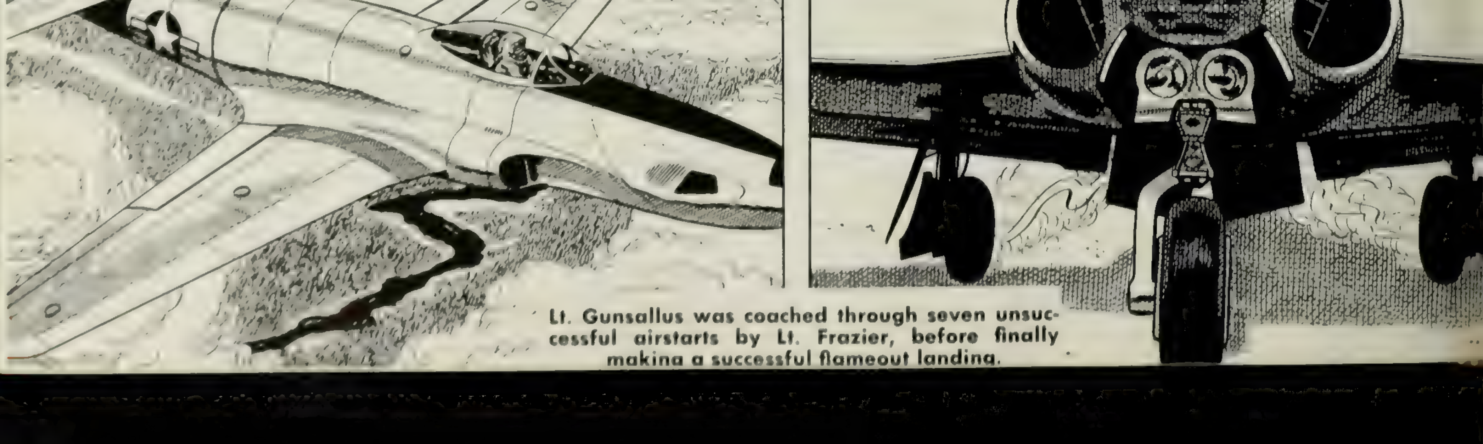
ON 1 April 1953, 1st Lt. Wallace N. Frazier was flying as "chase" pilot for his student, 2d. Lt. Glenn C. Gunsallus, who was making his fourth transition flight in the RF-80. While flying at 10,000 feet near Brunswick, Georgia, Lt. Gunsallus reported severe vibrations in the aft section of his airplane. Lt. Frazier advised his student to begin an immediate climb and establish course for Shaw Air Force Base.

When the two ship element reached 25,000 feet, Lt. Gunsallus' aircraft flamed out without warning. Lt. Frazier then calmly began giving gliding instructions and led his student to Hunter Air Force Base, Georgia, some 65 miles away. After gliding to 20,000 feet, the student was coached through seven unsuccessful airstarts. The last attempt was made at 4,000 feet above the 8/10 overcast at Hunter Air Force Base. A successful flameout landing was effected, with the student touching down within the first 2,000 feet of the runway. Due to battery failure, the radio failed after the last unsuccessful airstart.

Inexperienced as he was, Lt. Gunsallus performed like a veteran pilot throughout this flight, and Lt. Frazier's calm, thorough instructions enabled his student to land without further incident.

Lt. Frazier is assigned to the 18th Tactical Reconnaissance Squadron, 363d Tactical Reconnaissance Wing, and Lt. Gunsallus is attached to that unit for combat crew training.

FLYING SAFETY gives a hearty "*Well Done*" for this outstanding job of teamwork flying technique.



Lt. Gunsallus was coached through seven unsuccessful airstarts by Lt. Frazier, before finally making a successful flameout landing.

# Keep Current

NEWS AND VIEWS

• **The NADAR**—A compact fire and crash proof airborne tape recorder designed to log everything that happens during an airplane or missile flight has been developed by North American Aviation, Inc.

Using tiny miniature electronic parts, the small recorder called NADAR, from North American Data Airborne Recorder, originally was designed to "go along for the ride" on USAF guided missiles to report on altitude, speed, and general conduct of the vehicle in flight.

Carried by commercial military or private airplanes, the airborne tape can record important information during a flight as long as 10 hours. The tape can be run for another 10 hours non-stop with the previous information being "wiped off" as the new information is recorded. Over 500 hours running time can be racked up on the recorder before it needs a service check.

Locked in a sealed, crash-proof case, a 1200-foot magnetic tape carries the log of a complete trip, including conversation in the cockpit, communications from the ground, data on pressure, altitude, time elapse, vertical acceleration, airpeed, and direction. A quick check of the tape following an unexpected ncident during flight would give engineers a full report of everything hat happened in the airplane from akeoff to the time of termination.

An 18-pound unit that fits snugly nto wing roots or luggage compartments, the recorder is composed of many Tom Thumb size parts designed nd developed in the company's Electro-Mechanical department for uidance mechanisms of missiles. Much smaller than recording instruments with comparable capabilities, he airborne recorder is about the ze of a portable typewriter.

**Unlucky Strike!**—Ever hear of n oxygen mask fire? One occurred ecently that resulted in first and secnd degree burns on the hands and gs of an F-86 pilot.

The incident happened after the fourth puff of a cigarette at 10,000 feet cabin pressure during a normal letdown from an altitude interception mission. The oxygen mask ignited, and the flow of oxygen from the system—regulator in SAFETY position—forced a solid flame from the mask about 12 inches long. To avoid face burns, the pilot blocked the flames with his left hand while forcing the helmet off his head with his right.

When the flame was clear of his face, he switched the oxygen regulator from SAFETY to NORMAL, which stopped the pressure flow and consequently the flames. He then extinguished the smoldering fire that remained in the mask by smothering it on his leg. An uneventful landing at the home base followed.

No excessive oxygen pressure with the A-14 regulator in SAFETY position was discovered by investigators, and it was *their* opinion that the pilot's use of the SAFETY position was the primary cause of his injury. He also was criticized for not wearing gloves to protect the hands during a fire from any cause.

This incident is worth mentioning because it can serve as a "caution sign" to all pilots operating this type oxygen system.

*Craig AFB, "Plane Talk"*.

• **AF Information Films**—The Air Photographic and Charting Service has announced that Air Force Digest No. 1, first in a new series of Air Force information on films, has been completed and forwarded to the field for immediate use.

Initiated as a project with a twofold purpose—to place unclassified pertinent information on Air Force activities before interested audiences by utilizing footage shot for documentation purposes—the Air Force Digest will contain only information of an unclassified nature and will offer excellent material for the information and education program. Each film will be approximately 14 minutes in length. A new issue of the Digest will be forwarded to Air Force units all over the world every three weeks by automatic distribution through the AF Area Film Libraries.

Air Force Digest No. 1 covers four activities:

☆ Research on foreign objects entering airscoops for jet engines.

☆ Air Force mobile communications units in operation in Europe.

☆ The training of Greek Aviation Cadets by USAF and England.

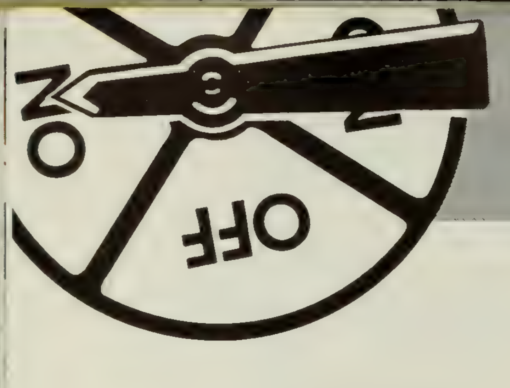
☆ And a final regular feature of Digest No. 1, the "Did You Know?" picture shows the ME-163 rocket powered interceptor captured from the Germans at the end of World War II. The pilot who made the flight shown in AF Digest No. 1 is now in the United States, assisting the Air Force and rocket powered research and development.

An official of the Air Photographic and Charting Service says, "We believe that this series, produced entirely from footage supplied by APCS camera units and processed by our regular in-service facilities, will bring current, interesting information to the attention of AF personnel throughout the world."

Distribution of the Digest will be made automatically by the area film libraries at bases and units within their areas. In order to gauge reaction to the new series and gain constructive criticism, area libraries have requested using units to complete preview questionnaires on issues as they appear, and return the completed forms to them for evaluation by the Air Photographic and Charting Service.

Actual F-86 dogfights against Communist MIGS in Korea, including gun camera footage of Sabre kills, are included in the second edition.

Base Information Service officers have been advised to make the Air Force Digest available to the AF Reserve units, other activities affiliated with the Air Force, and interested organizations in the area. The Digests are also cleared for non-profit TV and theater use.



# Cross Feed

### Gardella's Pix

Six of the twelve pictures used in June Flying Safety's "Survival in the Tropics" were taken by Capt. Paul Gardella, Chief, Survival Training Unit, 19th Air Div., Carswell AFB.

The survival unit at Carswell is excellent, and the personnel all well qualified and competent. Their interest in survival activities is unusually high, and I have never seen a more accommodating group.

**Maj. Bernard Garfinkel**
**Chief, Survival Training**
**Hq., Eighth AF.**

* * * * *

*Oversight unintentional. Pictures used had no photographer's identification, so kudos to Captain Gardella, belatedly—Editor.*

### Form 1 and Form 1-A

In your May, 1953, issue I was a bit astounded to see reference to the Form 1 and Form 1A. I know it has taken much time and work to acquaint pilots with the *new* Form 1 and its parts I, II, III, IV, V. Would you correct this so my students will again have faith in the A/C Maintenance Instructor? Thank you.

**M Sgt. James G. Smith**
**Det 550, AFROTC**
**Rensselaer Polytechnic Inst.**
**Troy, New York**

*You're in good form, M/Sgt. Smith, and we stand corrected for our oversight. The students may now have even more faith in their A/C maintenance instructor—Editor.*

### Flying the Right Side

I read your Flying Safety issue with a great deal of interest and look forward to each publication. It is most informative and enthusiastically presents each article and subject.

Lead time in publication does have its problems so the question I am about to ask is not a criticism of your method but something I would like clear in my own mind. The question concerns the fourth paragraph, page 13, of an article titled "The Pilots Good Book" in the June, 1953, Flying Safety magazine; and AFR 60-16A dated 27 May 1953, wherein the paragraph 11-a instructions state that aircraft will be flown to the right, etc.

Yes, I would like to know which is the most correct but most of all could you tell me the reasons behind the change of flying to the right rather than on the center. From my own experience I find flying the center of a leg to be easier and use the procedure of comparing volume transmissions of the "A" and "N" identification signals.

**Lt. Col. Harold D. Schmoldt**
**AFCAG-60, Hq. USAF**

*CAA has always prescribed the right-hand side of the course. So did the old 60-16 (1950). Believe Par. 11 of 60-16 (Feb. 1953) was a mistake, probably due to confusion with omni-range. AFR 60-16A (27 May '53) brings it back to the old rule again. No particular reason for it as far as we know, except that the old idea was that orientation was more certain, and collisions less likely when flying the "feathered edge"—Editor.*

### USAF Version of CAA's Ills

I have just read your latest issue and would like to say that ILS should not be considered as difficult for a pilot as you give the impression it is.

I run the Hq instrument school and find many of the pilots completely unfamiliar with it. After about two rides, they are invariably sold on ILS and prefer it to GCA. This is no doubt due to the generally low quality of our GCA units.

One point the Major is wrong on is that using an ID-249 for an ILS approach, you cut out the course line selector and have only localizer and glidepath sensing. You also lose the use of the No. 2 needle, which normally homes on the omni-station. The TO and FROM indicator is also out when using an ILS or VAR station.

**Capt. R. R. Lawrence**
**Hq. TAC, Langley AFB, Va.**

*This is all spelled out in T.O. AN-16-30-ARN 14-3—Editor.*

### Exchange of Publications

For the past two years the Flying Safety and Training Section at Tinker has been publishing a "Flying Safety Information Letter," and until recently distribution was limited to pilots assigned to this base. In February, 1953, however, Captain Robert A. Alger, Flying Safety Officer at Hill AFB, in Utah, wrote us, expressing a desire to establish a regular exchange of flying safety information between our activities. We recognized the value in such an exchange and put the idea to work immediately. To date, we have included all the bases of the Air Materiel Command in the distribution of our publication and would be pleased to include any other base requesting copies.

In April we received a letter from Headquarters, AMC, stating that our suggestion on the exchange of flying safety information was being sent to other AMA's and APD's.

We, in turn, would like to give credit to Captain Robert A. Alger, the FSO up at Hill, for the original idea and would be pleased to see such recognition publicized in Flying Safety magazine.

**Major Yorke J. Gunn**
**Chief, Flight Operations Br**
**Tinker AFB**

*Nice Goin', Tinker and Hill!*
*—Editor.*

### Used as Training Aid

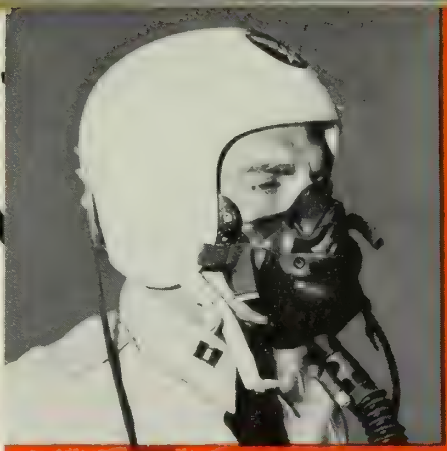
Here at Palm Beach International Airport, the Flying Safety magazine is read and discussed with unusual interest. In addition to certain subjects being discussed at accident prevention meetings and through the usual exchange of ideas whenever aircrew personnel get together, items are cut out from the magazine and presented in the various classrooms of either the C-124, C-97, C-54 or SA-16 Transport Training Groups.

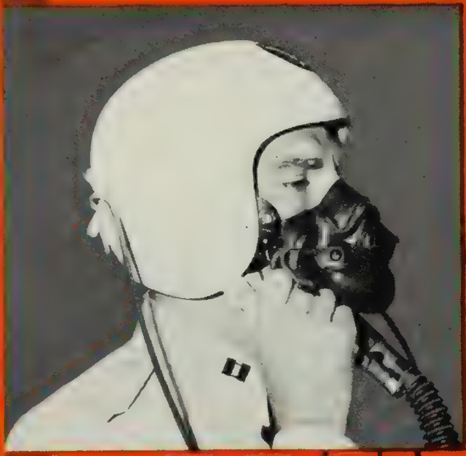
**James S. Keel, Maj USAF**
**Flying Safety Officer**
**1707th AB Wg**
**West Palm Beach, Fla.**

# STRIKE THE RIGHT NOTE!

**When flying, if trouble looms, strike the right note at the right time. Call it in or tap it out, but be sure you give the straight poop when you ask for help. The Air Rescue Service is designed to serve you in time of need but without the correct pitch, help may arrive too late.**

**If in trouble . . . stay tuned to Safety!**

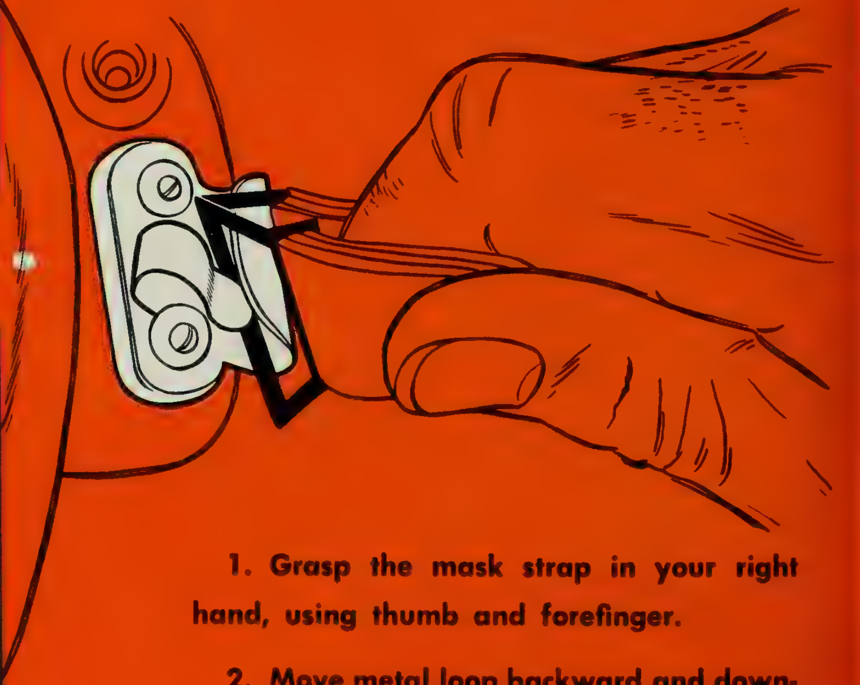


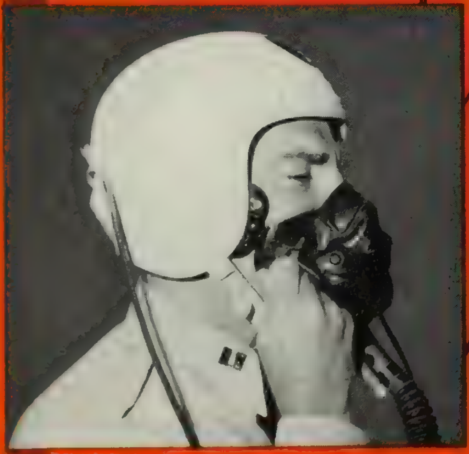


# GET IT OFF . . . QUICK!

There might come a time when you're going to have to get your oxygen mask off—real quicklike. There have been reported instances where pilots have gone into the drink and couldn't get the mask off—result—they almost drowned!

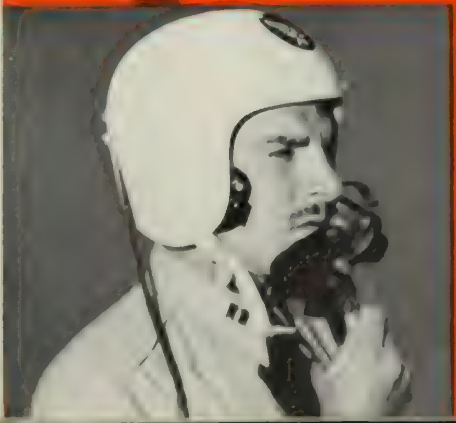
Here, in pictures and writing, is the procedure for shedding the mask—quick:





1. Grasp the mask strap in your right hand, using thumb and forefinger.
2. Move metal loop backward and downward against spring.
3. Continue downward motion, forcing spring out of clip with metal loop—and the mask is off.

*Caution*—While practice makes perfect, be careful the spring retains tension. Do not practice too many times, or it will be necessary to replace clip and spring.



***Know your personal Equipment for Safety***

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# FLYING SAFETY

NITED STATES AIR FORCE

SEPTEMBER 1953

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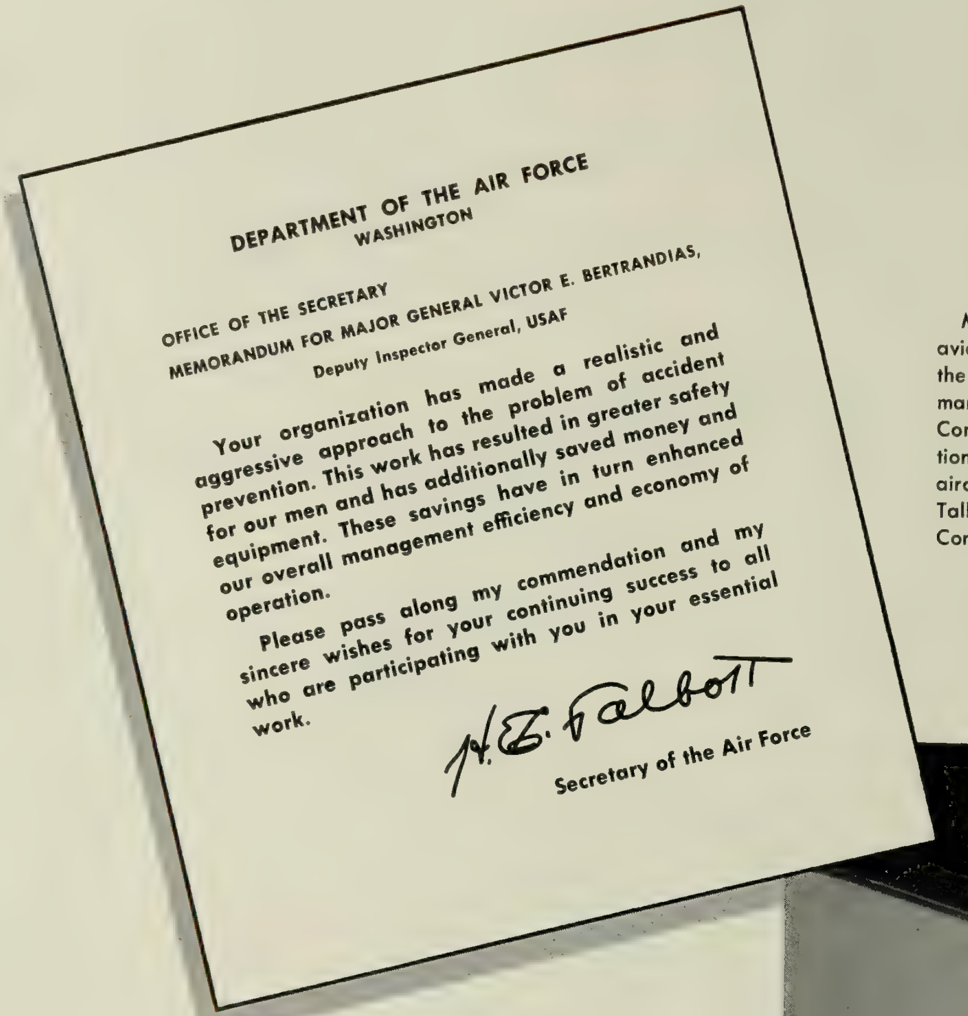
**THE HONORABLE HAROLD E. TALBOTT**
**Secretary of the Air Force**
**"AIRPOWER"**



DEPARTMENT OF THE AIR FORCE
WASHINGTON

OFFICE OF THE SECRETARY

MEMORANDUM FOR MAJOR GENERAL VICTOR E. BERTRANDIAS,
Deputy Inspector General, USAF

Your organization has made a realistic and aggressive approach to the problem of accident prevention. This work has resulted in greater safety for our men and has additionally saved money and equipment. These savings have in turn enhanced our overall management efficiency and economy of operation.

Please pass along my commendation and my sincere wishes for your continuing success to all who are participating with you in your essential work.

H. E. Talbott
Secretary of the Air Force

Mr. Talbott has long been associated with the aviation industry, having served as President of the Dayton-Wright Airplane Company, as Chairman of the Board of North American Aviation Company and as a Director of Chrysler Corporation. During World War II, he was director of aircraft production, War Production Board. Mr. Talbott served as a Major in the U. S. Signal Corps, Aviation Section, during World War I.

## Memorandum For All USAF Flying Personnel:

The commendation of the Honorable Secretary of the Air Force, Mr. Harold E. Talbott, applies to each member of each command of the United States Air Force who has contributed to the basic concept of accident prevention. Your application of the accident prevention program throughout the Air Force has achieved greater safety while increasing the effectiveness of our combat operations and training and has reflected efficiency in our management and supervision.

Your efforts and those of the Directorate of Flight Safety Research with its continuing and aggressive accident prevention program have brought about a lowered accident rate in the Air Force, with savings of many millions of dollars and valuable personnel.

Victor E. Bertrandias
Deputy Inspector General, USAF.

Department of the Air Force
The Inspector General USAF
jor General Victor E. Bertrandias,
Deputy Inspector General

★ ★ ★

jadier General Richard J. O'Keefe
Director
ectorate of Flight Safety Research
orton Air Force Base, California

★ ★ ★

Colonel John R. Dahlstrom
Supervisor of Flight Safety
Publications

★ ★ ★

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VOLUME NINE
NUMBER NINE

# FLYING SAFETY

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The Accident Board sometimes finds a few errors by the instructor. Turn to page 6.

# "our growin

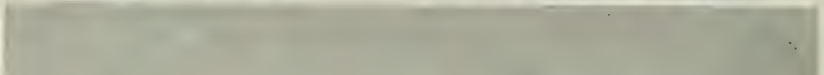
By Brig. Gen. Thomas L. Bryan,
Comdr., 1800th AACS Wing.
MATS Tinker AFB, Oklahoma

ONE of the responsibilities of the 1800th AACS Wing is to install and operate the military navigational aids and air traffic control systems for the Air Force within the continental limits of the United States.

These facilities include control towers, approach control, GCA and DF stations plus all the necessary ranges, beacons and various navigational aids needed to support the ai traffic control system.

In addition, AACS is responsible for the support, in a communications sense, of all strategic and tactical missions of the Air Force. AACS fits into the national air traffic control picture for the military pilot in the same way that the Civil Aeronautics Administration and the commercial

**Since the advent of jet aircraft, the air traffic control people have been faced with many new and complex problems.**



# t traffic control problem . . ."

## ather, Emergencies and Equipment Failure Add to the Complexities of Any Air Movement Situation

airlines communications systems fit into the civilian aviation picture. In he continental United States, AACS is responsible for terminal control of military air traffic. Overseas, AACS acts as the control agency for en route and terminal air traffic, as well as performing the "company" communications missions.

Our air traffic control job has always been a difficult one because of he varied situations that develop within any air movement situation due to weather, emergencies and possible failure of ground and airborne equipment. With the advent of he jet airplane, the air traffic control people were faced with a new and even more complex problem. Conventional aircraft posed many control difficulties, not the least of which was the Berlin airlift. This situation was finally whipped by assuming omplete control of all air movement actors. Pilots were told how to take ff, when to take off, how fast to fly, what kind of approach to make and ow to taxi at the end of the run. Because of the traffic, and the splitecond timing vital to the success of he lift, many of the pilots' prerogaives were shifted to AACS.

With the present situation involving "mixed" traffic . . . jets, heavy ransports, slow aircraft and large ombers interspersed, it may be that modified "Berlin" system is the ltimate answer.

Stop and consider some of the diferences in the characteristics of jet nd conventional aircraft, some of which border on the fantastic, and all f which affect, in some way, the air raffic control problem. These differnces include rate of climb, rate of escent, high cruising speeds and igh altitudes. These factors are almost the exact opposite of those of onventional aircraft. Other factors re higher takeoff speeds and landng speeds, higher fuel consumption (for instance, in one type of jet, 100 allons of fuel means five minutes' ying time at 1000 feet, but 35 mintes' flying time at 45,000 feet), eather conditions and alternate airorts. Due to the critical problem of fuel load versus fuel consumption, sometimes two and even three alternates must be planned for jets.

Another important factor is the critical range of jet aircraft. Tactical personnel must plan missions that take a bare minimum of fuel reserve in order to realize full utilization of such aircraft in tactical missions. In some cases, an unplanned go around could mean trouble.

### Straight-In Approach

In the opinion of AACS, the easiest method of letting down into an airport is the straight-in approach from altitude. This is especially true in the case of pilots flying "hot" airplanes under IFR conditions, where the minimum number of turns is required. In addition, this method is the most economical. Standardizing such an approach is difficult, but AACS is striving toward a simplified method, taking into consideration locations of navigational aids and airspace restrictions.

Not the least of the controller's problems in relation to a straight-in approach is that of approach over metropolitan areas such as New York. For example, how can a jet be cleared for a straight-in approach from 40,000 feet, 60 miles out from destination, if that airport should happen to be New York, Cleveland, San Francisco or Kansas City? How would the other traffic in the area be handled? What if contact with the jet should be lost, after he had been cleared down through the assigned altitude of practically every airplane in the area? This is why the progress is slow and tedious.

The big problem, and the most unsolvable, is that of sufficient airspace in the United States. If sufficient airspace were available, key navigational aids could be installed around a given airport at an adequate distance to allow jet aircraft to start descent from 40,000 feet, and let down straight into landing. Naturally, the expense of such a system would be prohibitive. The obvious answer to this problem would be the establishment of specific air corridors or areas for jet aircraft, and other areas for conventional aircraft. This method has been employed, but the system will not work in the area of terminal airports, where routes are at a premium.

Another problem that poses itself is the limitations of our present navigational facilities at high altitudes. Definite difficulties can be foreseen at altitudes above 40,000 feet. For example, what is the width of the cone of a low frequency range station at 40,000 feet and above? Would the pattern of a fan marker placed ten miles out from the range station "Z" marker interfere or overlap the "Z" marker pattern? Does the configuration of the range leg remain the same at high altitudes? How does VOR work at such altitudes? AACS has all these problems under careful evaluation at present. All possibilities are being exploited, and these possibilities may dictate a resurvey and relocation of many of our facilities.

There is no magic formula that will solve all of the difficulties in the field of air traffic control, but AACS is moving in the right direction.

The immediate steps toward solution of the problem are those of developing and establishing radar and radar systems to aid the controller in handling air traffic. Until all the new "gimmicks" are installed, the best method is the wise employment of the systems now in use.

AACS is in the process of establishing approximately 50 radar air traffic control centers in the United States. These centers are composed of terminal radar capable of high altitude coverage to approximately 20,000 feet with horizontal coverage of approximately 40 miles radius, and precision radar capable of handling two or more airplanes on the final approach simultaneously. Long range radar is being installed in some locations, capable of high altitude coverage, and a radial coverage up to 200 miles. All of this radar equipment is consolidated within a single room, allowing centralized control of the entire system.

AACS believes that radar is best used as the *primary* means of approach control. This belief is based on the need for simplifying the work of the jet pilot. This does not mean that radar itself is a complete system. Only by proper placement and utilization of all facilities in the area can an efficient system be accomplished. However, radar does simplify the entire picture.

With the proper radar system, a jet can be picked up 40 miles away at altitude, and brought to a landing without utilizing any other navigational aid. But there is a limit to the number of aircraft that one operator can control. Because of this, a combination of navigational aids is used, in order to provide the widest safety factor as a backup.

It is planned to use automatic ILAS and GCA in conjunction with our RATC centers to speed up approaches and reduce the work load on the precision radar operators.

ILAS has been found invaluable in the event of radar failure in that the pilot can divert his attention to working the ILAS, and continue his approach normally.

Radar is not infallible, but it's still the best instrument at hand.

One problem that besets radar control of jet aircraft is the small reflecting surface of the jet. Jets are difficult to see on the radar, and they travel at high speeds, making tracking difficult. One solution to this problem is an airborne responder that intensifies or increases the size of the blip. Care must be exercised in controlling aircraft equipped with a responder at long range and at great altitude, because the fact that the aircraft can be seen on the scope sometimes lends false security to the observer, in that other non-equipped aircraft are in the same area, but not on the scope.

Looking into the future, here is a rundown on some of the systems that are in the mill.

## AGCA vs. ILAS

An old saying "differences of opinion make for horse races" has been around for a long while. Back around 5000 B.C., Ug, who had always dragged his wife along by the hair, disagreed with Pog, who favored dragging his wife by one foot. Both methods gained the same end, that of getting the missus to the point of termination, albeit slightly ground weary. During the middle years of aviation, many beers and much wind were expended in furthering or refuting the theory of control surface action in a vertical bank (if you are in a vertical bank, does the elevator act as a rudder, or vice versa?). Today, there is much hangar-yak centering around the comparative value of ground controlled approach (GCA) and instrument landing approach system (ILAS). Both are used by the Air Force. Note the term "approach." Neither of these systems is a blind landing system — yet. Blind landings, however, are the goal of both these systems, which are still in the process of development, and which still depend to a great extent on lighting design and runway length.

**Brig. Gen. Thomas L. Bryan**

General Bryan ranks as one of the top electronics experts in the Air Force. A veteran of 24 years service, he has been engaged in communications work since 1942, when he commanded the Radar School at Boca Raton, Florida.

During the War, he was Communications Officer, 5th Air Force, and then became Chief of the Operations Section, Electronics Division, Headquarters, Wright Field, Ohio. He was a Technical Observer at both the Bikini and Eniwetok Atom Bomb tests from 1946 to 1948.

Prior to assuming command of the 1800th AACS Wing, General Bryan commanded the 10th Air Div. (Def.) in Alaska.

Automatic GCA and automatic ILAS are refinements of the respective systems. Both are aimed at completely automatic approaches and much progress has been made in each system. No doubt when both are perfected there will still exist the same old argument as to which system is best. I, for one, plan to wait and see, while urging the development and utilization of both systems

## Pictorial Computer

The CAA Technical Developmen and Evaluation Center is presentl working with a new computer whicl is capable of plotting an aircraft' track over a given map area. Th equipment can be mounted on th instrument panel of the aircraft o in the portable version, can be place in the pilot's lap. The pictorial computer utilizes information from th distance measuring equipment an the omnirange receiver and continuously indicates on a chart the position of the aircraft with respect t the omnirange station. This type o equipment may well be one of th answers to the jet navigational problem when the equipment is perfected

These new systems or aids wil probably prove very useful in th future and are adapted to inclusio into our present systems. I believ completely automatic flying and automatic systems are not too far away however, we can and should do everything possible to refine and modif our present systems to meet our mor immediate needs until we do chang to this automatic status.

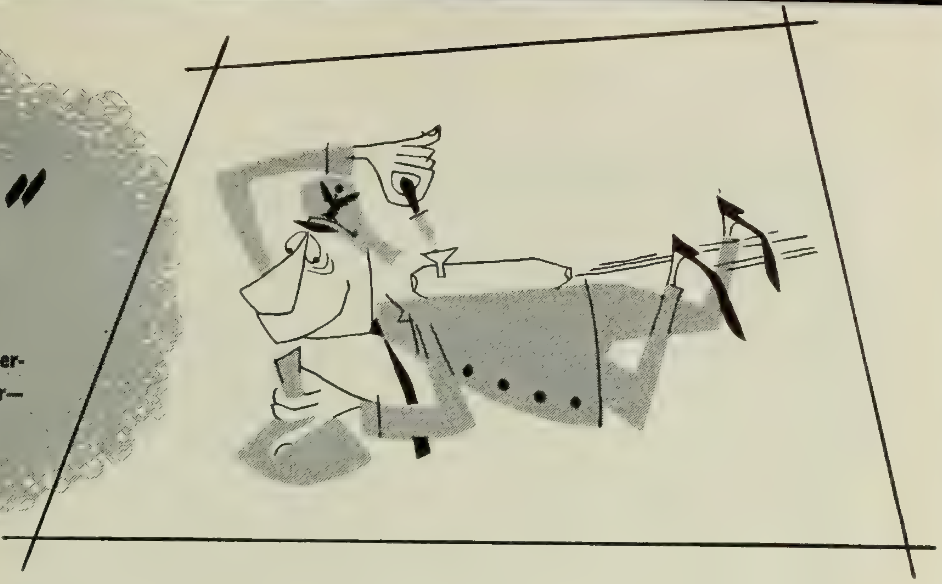
We in the Air Force are extremel distressed by the increasing number of mid-air collisions. Today's modern airplanes with all their knobs handles, levers, gages, dials, hydraulic systems, electrical systems etc., are masterpieces of ingenuit and genius. Their increasing speed are virtually changing the meanin of space — space as the old pilot knew it 20 or 30 years ago. Ther was a time when the pilot had nothin to do but crank 'er up, point 'er int the wind, and he was airborne. H could take off, fly around for a spel and land in almost any cow pasture never having to touch anything i the cockpit except the stick, rudde and throttle. He had a lot of fre time to look around.

AACS is doing everything it possibly can to solve air traffic contro problems. AACS works constantl with CAA and other agencies in attempting to devise streamlined, saf air traffic control procedures whic will benefit all concerned.

Any ideas you may have on thi subject will be welcome. We ca progress in this field only if al agencies work together and pool thei "know how" in this business whenever the opportunity arises. ●

# "Home, James!"

**All-Weather jet pilots of the 68th Fighter-Interceptor Squadron have found a new soup-cutter—**



**By 2nd Lt. Dick Myers, RO, 68th Ftr.-Intcp. Squadron, APO 929-2**

LET'S QUOTE: "Air Navigation, by definition, is the art of determining the position of an aircraft at any time and directing the aircraft from one position to another."

This is the first sentence in the Introduction of Air Force Manual 51-43. The manual is titled "Air Navigation for Pilots." It is a standard reference work for almost all of the Air Force's rated officers. It goes on to outline the fine points of getting from "here" to "there," using all of the standard instruments and aids encountered in the AF's aircraft.

Air Defense pilots are extremely conscious of instrument techniques, and log a high percentage of time in the "night" or "weather" categories. Being IFR-minded, they know the importance of using all available facilities as cross-checks. Good "Flying Safety" dictates that the pilot utilize all his available information in "spotting" himself in the air.

In line with this doctrine, pilots of the 68th are depending more and more on a new source of information in addition to the commonly accepted radio aids. This "new" source is actually an old member of the Air Defense team, the Radar Observer. Strapped in the two-place fighter behind the pilot, the RO's specific duty is to search for the unidentified target on his radar screen, plot the track of the bogey, and swing the interceptor around into "collision course," using a rapid-fire series of commands to the pilot for speed changes and turns. Now, the RO's of the Lightning Lancer Squadron are not only lining up gunsights on bogeys, but pinpointing the positions of their own aircraft as well, utilizing the limited-function radar set.

## Radar Check

When used for a navigation assist, this short-range radar is most often employed as a check on the normal Radio-Beacon facilities. This technique is made possible by the fact that most of the flights are over water, which shows up on the radar screen as an area of "no return." This blank area is broken up by distinctive shoreline patterns and numerous small islands, each possessing its own individual shape, and represented by a glowing "ground-return" indication. The result? A moving, electronic "map" of the immediate area, elongated and misshapen, but quite adequate for navigation if watched carefully.

One of the first tricks a new RO is taught by the "old hands" in the squadron is the identification of "Horseshoe Island," a tiny but unmistakeable half-moon of an island just off the coast. Another is "Pear Shape," farther out, and appropriately named. These little islands are picked up by the RO's in aircraft approaching at altitude, and plotted to verify the pilot's ADF approach to the letdown point. Should the radio compass show any skittish tendencies in heavy weather, the pilot can always ride in on a "null." But sighting the "point" on radar is foolproof. So all the pilot has to do is line up with the "pip" and come on in. Nice. It works every time.

Here's number 626, inbound in the soup after a routine armed-patrol mission up the Japan Sea. The GCI controller on the ground has steered the crew in, and obtained clearance for the ADF letdown. GCA is alerted and waiting, and 626 is approaching the high cone. Let's plug into the interphone. Over the high-pitched whine of the turbine, the breathing of the tandem crew sounds a steady "Sss . . . Sss . . . Sss. . . ."

**Pilot:** *"Got anything yet?"*

**RO:** *"Not yet. Wait a minute—Here comes Pear-Shape. I should read more, soon."*

**Pilot:** *"Roger. What ETA over the homer?"*

**RO:** *"About 20 more seconds. Now I have Horseshoe — it's sliding to the port side. Correct five degrees. Now three more, and we're lined up. Five seconds, now, Ready—Hack!"*

626 pops out speed brakes, and pitches into its steep descent outbound. More spot-checks on the scope. Looks OK. On the inbound leg, should the birddog cut out at any point, the aircraft can be jockeyed into position for a GCA by a few more words from the RO. The Observer in 626 is still merely monitoring the usual ADF, but in case of need for it, he has his own landmarked letdown, and can take over from the radio compass and direct the descent at any time.

The beauty of it is that in time of an actual air attack these men won't be hampered by loss of radio aids. The system not only provides a *positive* reference to the field, but a simultaneous search for other traffic that may be unknown to the Control in the area or hostile to our installations. Practice is accomplished on clear days for safety's sake, and the "Scope Dope Letdown" coincides nicely with the compass indications. After a dozen or so "dry runs," an RO has it pretty well grooved, and knows just how the letdown will look, day or night, VFR or IFR. It looks as though these boys will continue to use "all they've got" in weather. No confusion. No collisions. No sweat. ●

# you CAN'T EXCUSE the teacher!

If an IP fails in his responsibilities, he is planting the seeds for an accident.

**Accident Board Findings:**

*"Primary cause of accident attributed to failure of the instructor pilot to maintain proper spacing in the pattern and to his failure to clear the aircraft properly on final."*

**Accident Board Findings:**

*"Primary cause of the accident is that instructor pilot misjudged distance and altitude, failed to check clearance on the glidepath, and planned his approach improperly."*

**Accident Board Findings:**

*"This accident was caused by the failure of the instructor pilot to keep a safe margin of airspeed on final, although warned that strong gust conditions prevailed on the runway."*

Each of the above quotations are taken from a report of a major accident. They are conclusions reached by Aircraft Accident Investigating Boards concerning the causes of the three accidents.

Unfortunately, these are but a few of the many accidents which occurred during 1952 and the first quarter of 1953. Actually, there were 128 major and 102 minor accidents during this period in which instructor pilot error played a major role.

An instructor pilot has a special responsibility not shared by others. His job may be to teach all phases of flight maneuvers to unrated students. It may be to increase and maintain proficiency in currently rated pilots, in a specific aircraft.

In either case, a fundamental part

**This T-6 was piled up because the IP let the student "go too long" without correction; cockpit confusion caused the C-45 accident.**

of this teaching is to instill safe flying habits in his student, both by example and by instruction. If he fails in either respect, he is laying the foundation for an accident.

An instructor pilot must exercise good judgment in dealing with his student in many diverse ways. A student pilot picks up and retains his instructor's flying habits. If these are careless or dangerous, they will be magnified by the student's inexperience and lack of technique.

By riding the controls too heavily and by questioning the judgment of the student too frequently an instructor pilot can destroy the student's confidence. On the other hand, by allowing the student too much leeway, he may be inviting an accident. An IP's job is to maintain the proper balance between the two extremes.

When instructing a rated pilot, an IP faces a different problem. He knows his student has the basic knowledge and ability to fly the aircraft. However, his experience level can cover a wide range, and considerable instruction may be necessary for him to become proficient.

In cases where the student's experience in an aircraft type is limited, an IP must be careful not to take too much for granted. Too little supervision and instruction and too much leeway and carelessness can lead to extremes in trouble.

To illustrate what happens when an IP fails to do his job properly, take a look at some accidents involving IP error.

An aviation cadet flying a T-6, with an IP in the rear seat, hit a tree while on final approach, substantially damaging the aircraft. The IP admitted that he had allowed his student to make an excessively wide base leg and a long, low approach without correction.

The student got so low and slow that neither pilot was able to see a 40-foot tree some distance from the end of the runway, until right on top of it. The IP then jerked back on the controls and gave it full throttle, too late. The aircraft mushed into the tree, recovered and hit on the over-run.

Accident causes were listed as misjudged distance and altitude, failure to clear flight path for obstacles on low approach and improper planning by the instructor pilot.

A T-33 received major damage when an IP allowed his student to flare out too soon and too high in strong gust conditions. The student started flareout a considerable distance from the end of the runway but the instructor pilot made no correction. They were warned by mobile control that strong gust conditions prevailed and instructed to hold sufficient airspeed to compensate for the gusts. The aircraft hit 100 feet short of the runway and tore off the gear and buckled both wings.

**This accident, brought about by an IP's late corrective action, resulted in the loss of an SA-16. Mission was a short field check-out.**

Accident causes were listed as failure of the IP to hold a sufficient airspeed and failure to make corrections in time to compensate for the student's poor pattern.

A B-25 was washed out in a similar accident. In this case, the instructor pilot stated that he had taken over the controls on several previous landings when it became evident that the student was going to land short.

The IP stated, "I decided that I would let him go ahead on the next landing and, if necessary, I would talk him down." The B-25 was leveled off high, stalled and hit extremely hard on approach end of the over-run. The IP had advanced full throttle just as the plane hit but was many seconds late. The fuselage was buckled, one engine torn loose, gear damaged and the IP's windshield completely shattered.

Another accident caused by an IP's late corrective action resulted in the loss of an SA-16.

In this instance the student was being checked out in short field, JATO takeoffs. After rolling a short distance down the strip, the student pulled the amphibian off in an extremely nose-high attitude, at a low airspeed. As the nose came off, the tail skid contacted the runway and dragged for several hundred feet. After becoming airborne the pilot maintained the nose-high attitude until one wing partially stalled.

Attempting to get his wing up, the pilot retarded the power on one engine. Up to this time in the flight the IP had made no attempt to correct the student's obvious mistakes. Finally, seeing that the student was unable to get the wing up, he took over the controls, cut power completely on the engine and managed to level the wings momentarily.

As the instructor pilot reapplied power, the other wing dropped and dragged on the ground and they were off through the boondocks. The aircraft hit, sheared the gear, tore up a wing and damaged the hull. In spite of the deep marks where the tail dragged on the runway, the IP stated, "The takeoff looked normal to me, all the way. I couldn't believe it when the wing dropped."

High on the list of accident causes

attributable to instructor pilots is that of poor briefing and inadequate explanation of intended maneuvers. No student can be blamed for an accident that occurred because he wasn't told how to perform a maneuver or procedure. True, if the instructor's explanation isn't clear, he should ask questions. But often, if something is omitted, the student has no way of knowing that his briefing is incomplete.

A typical example of this is the IP who "forgot" to brief one of two students he was checking out in a C-45. Both students were scheduled for the flight and were to switch off in the left seat.

Somehow the instructor pilot neglected to inform his second student just who would be responsible for throttles and gear on a go-around. On the first landing the pilot touched down, skipped and ballooned up about five feet. He then applied partial power to ease back down to the runway, but the IP, assuming the student was going around, had started to retract the gear.

As the aircraft settled, the IP poured on the coal in a futile attempt to stay airborne but both props hit the runway and the plane bellied in.

The student stated that he was under the impression that the IP would handle the power for a go-around. He said that after recovering from the bounce he had cut the power, intending to make a normal landing. Board findings were that the instructor pilot had failed to brief the student adequately and the resultant cockpit confusion was responsible for the accident.

Overestimating a student's ability, combined with carelessness, caused one IP to eject from his tail-less F-84. Fortunately, the student was able to get his badly damaged plane home.

The student was being checked out on his first acrobatics ride in an F-84. He had limited jet experience, with very little time in an F-84. After running through a series of confidence maneuvers the student was instructed to do a loop.

The instructor pilot in the chase plane moved in close as the student pulled up into the beginning of the maneuver. At the top, the IP noted that his airspeed had fallen off very low and instructed his student to tighten up the loop. At this time he lost sight of the student but continued on around although he knew he was in danger of over-running the lead ship. As they came through the horizon the chase plane's tail was sheared and the plane went out of control in an inverted spin.

The accident board decided that the accident could have been avoided if the IP had been more aware of his student's limited experience and had kept his aircraft in sight by remaining farther out and away.

Another accident in which the IP over-estimated his student's ability ended with a severely damaged B-47.

The student had trouble maintaining proper approach speed and used poor technique on his roundout. He then overcontrolled and made abrupt, rough movements attempting to get the aircraft in a landing attitude. The IP made no correction and did not take over the controls until after the plane stalled in, short of the over-run. After initial impact the plane bounced up to the runway and the IP was able to recover.

During the investigation, the IP commented, "His progress had been satisfactory and I thought he was doing okay on this landing. When I realized that we were going to hit short, it was too late."

Perhaps the best example of what can happen when an IP neglects his duties is that of a recent T-33 crash.

After entering the pattern the student flew erratically on his downwind and base legs. The instructor followed him through on the controls, while giving instruction over the interphone. Testimony during the accident investigation revealed that the student was not briefed properly on cockpit procedures, had failed to use a landing checklist and didn't know the base SOP for a landing check.

Under these conditions, trouble was inevitable. The student moved the gear handle toward the down position but not far enough to activate the system. The situation now became critical as the IP neglected to cut the throttle for a horn check and didn't bother to look at the gear warning lights for a safe indication.

Instead, he switched to VHF and called in gear down and locked as he turned on final. Mobile control made several calls to warn the pilot that his gear was up. They finally shot a flare to send the plane around. Despite the warnings the aircraft came on in and made a very smooth landing—on the belly.

Another major accident cause is the failure of many IP's to look around and keep themselves cleared at all times. This hazard is especially true in the traffic pattern and on instrument training flights. In this type of accident, the IP's failure to look around often ends in a collision with another aircraft, frequently with fatal results.

Two such accidents this year caused the loss of three T-33's and one F-80, with three fatalities.

In one, involving two T-33's, an IP entered the pattern behind a three-ship formation. The number three man lagged behind his flight and the IP cut inside of him on the base leg. Both rolled out on final at approximately the same time, with the solo student slightly lower and ahead of the dual airplane.

Mobile control warned both planes that they were closing rapidly and finally sent the number three man around. As he pulled up on the go-around, his aircraft collided with the dual plane, who had continued his approach, and both crashed and were totally destroyed.

Witnesses to the crash testified that at no time did the dual airplane deviate from its course and that it was obvious that the IP did not have the other aircraft in sight, in spite of the warnings from the mobile control.

In the other accident, a T-33 and an F-80 were demolished when the T-33 landed on top of other aircraft.

As the two planes turned on final, the T-33, who was number two in the pattern, started to overtake the F-80. Both planes were sent around but the student in the F-80 reported he was low in fuel and would have to land. The IP in the number two plane did not acknowledge the transmission and continued on final. Just as the F-80 touched down, the second aircraft landed on top of him and the two interlocked airplanes careened down the runway. Amazingly enough, no one was injured but both aircraft were a total loss.

Every kind of aircraft from jet bombers to liaison planes and helicopters figured in accidents involving instructor pilot error in the 15-months period surveyed. In almost every instance the accident could have been averted entirely if the instructor pilot concerned had performed his duty properly. Be sure that you, as an IP, don't end up as a statistic through neglect and carelessness. ●

# "I'll come where you're to—"

**By Major James T. Butts, Base Air Operations Officer, Ernest Harmon AFB, NEAC.**

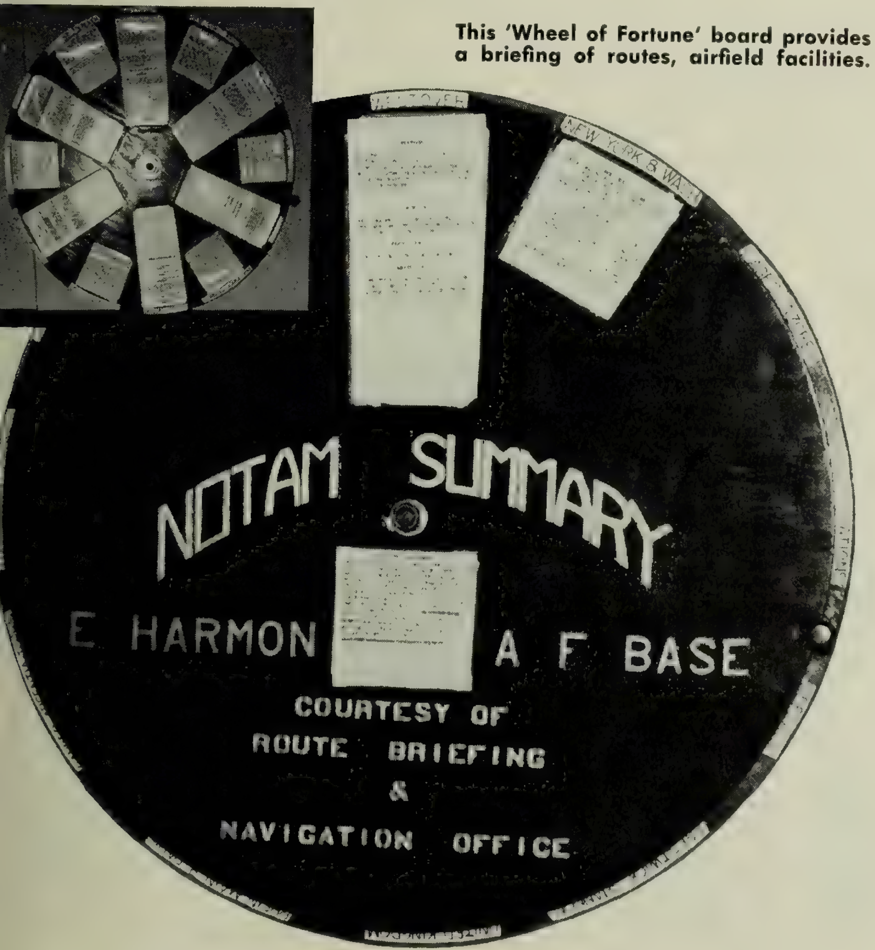
UP IN THE NORTH COUNTRY, the "Newfies" have a provincialism, used in advising those who are lost, to wit, "Stay where you're at, and I'll come where you're to." Pilots departing Harmon AFB, after using the "easy-dial" NOTAM system in use there, can say: "I'll come where you're to, safely, that is!"

Every pilot is familiar with the hassle involved in checking NOTAMS at many bases. In too many instances, the NOTAM file is placed on top of the dispatch desk, and that intelligent soul who is eager to learn all about route information is forced to climb over a gaggle of pilots filing clearances, two line-taxi drivers, and eight sailors looking for a ride to Canarsie or Cucamonga.

Assuming he can finally get in position to pull open a few NOTAM drawers, the Searcher for the Truth must then interpret the "cable-ese" of the TWX's therein. This operation, in itself, is no child's play. Assuming, of course, that the NOTAM file has been kept up to date.

This problem has been licked at Harmon by the manufacture of a revolving NOTAM Route Board which looks very much like a large wall-sized computer. The board is the brainchild of Captain Robert W. Givens, Route Briefing Officer, and Airmen C. S. Dodge, L. R. Cundall, and D. J. Anderson, radio operators in the briefing section.

The circular board provides quick, efficient and practical briefing of routes and facilities and insures knowledge of usable airfields along the various proposed routes out of Harmon AFB.



This 'Wheel of Fortune' board provides a briefing of routes, airfield facilities.

The circular board is the outcome of the realization that too few pilots were showing interest in late NOTAMS. Those who *were* interested placed an extra load on dispatch and briefing personnel who were charged with giving pilots all available information. This had to be done verbally, and when operations was busy, some confusion resulted.

The briefing section went to work on designing some sort of visual presentation that would be easy to operate, and that would present complete information. After considering numerous gadgets such as a Colt '45', a curvaceous blonde, or a Newfoundland lobster nibbling on a pilot's ear, the section finally came up with the idea of this rotary information board.

It was discovered that it would be very easy to design a NOTAM wheel in the form of a ship's steering wheel, and arrange it so information at destination and along proposed routes always appeared at the top of the wheel, in a small window for easy reading. In another window all necessary information is shown on available alternates.

The rotating board was manufactured locally, and the NOTAMS are typed on a four by eight inch card, inserted behind the windows. Cards can be replaced or corrected very easily. In front of the revolving wheel is a stationary wheel that serves as a cover, and identifies the board.

In addition to this NOTAM board, a memorandum NOTAM summary is given to all pilots for information while in flight.

Since the board was completed, all pilots have shown great interest in NOTAMS . . . and can say, without fear of contradiction, "Stay where you're at, and I'll come where you're to . . . SAFELY!" ●

# Finding Facility Facts

By Lt. Col. Robert L. Van Ausdall,

Senior Air Inst., 104th ANG Ftr. Sq.,

Harbor Field, Maryland

*THE author, a senior pilot with 3500 flying hours, has been flying fighters most of his Air Force career. During IFR flights in F-51 aircraft he always had trouble with "paper work" in the cockpit. Maps, letdown books, E-6-B computers and Radio Facility Charts always seemed to be cluttering up the few inches of space left in the cockpit, so he decided to analyze and study his available aids with a view to saving time in locating the information he needed. This article is an outcome of his study of the US edition of the Radio Facility Charts and it is presented with the hope that not only other fighter pilots but all users will learn some new facts that will save them valuable time and help promote safety through more intelligent use of the charts.*

★ ★ ★ ★

BEFORE you put this down and say to yourself, "I've used Radio Facility Charts for years, why should I read anything about it?", answer these "True-False" questions:

1. Approximate reception distance of each radio range can be estimated quickly in the Radio Facility Charts by looking at the end of the range leg.
2. A radio range which is shown with an extended leg can be received farther away on that leg.
3. All mileage in the charts is statute, mainly because ATC does not accept nautical miles for IFR flight plan information.
4. An airport symbol which is outlined with a square box means that station possesses either UHF/DF or VHF/DF.
5. All bearings on radio range legs are true bearings.
6. When the frequency of a radio facility is underlined on any of the pages of the Radio Facility Charts, that facility is without voice.

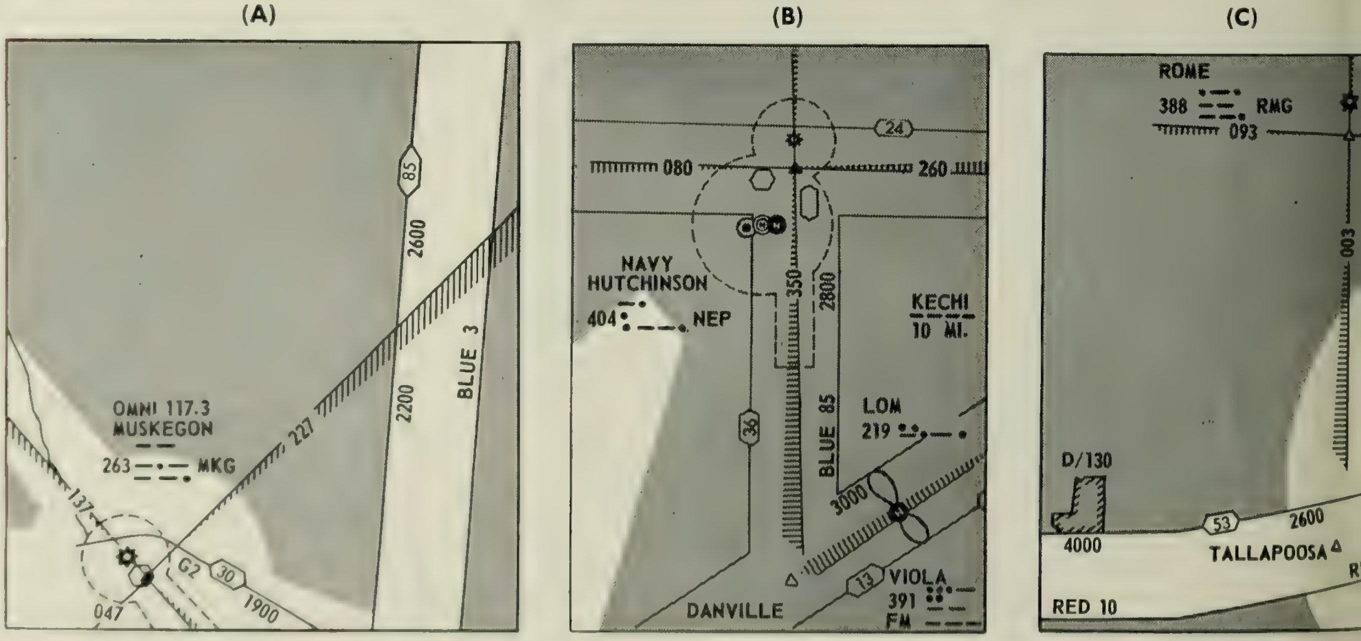
You should get all these answers right, but check for correctness at the end of this story.

The above questions refer to only six of the hundreds of aids offered by the Radio Facility Charts. If you missed one of these or even had to guess on one, better read the article. It will only take you 16 minutes. All of these aids when understood and quickly recognized can save much time and trouble and will consequently promote flying safety.

### It's in the Book

Let me give you an example. Last month during an instrument check, the pilot I was checking made five calls to "Dover (Delaware) Radio" trying to give a position report. In addition to all the written information opposite Dover showing that its range has no Air/Ground Voice, the frequency is underlined on the page next to Dover's range and call sign. (The page which he had spread open

Extended range leg can denote change in minimum en route altitude (A) or reporting point intersection (B) or both (C).



on his lap.) A quick glance at any range frequency in the book will reveal the same information.

*If the range frequency is not underlined, it has voice. If it is underlined, it does not have voice.*

Examples of the three different ranges can be seen on the Los Angeles blow-up page (103B in the current edition) of the Radio Facility Charts. Los Angeles Range is strong. Its range ends *point out*. It can be received farther away.

Burbank Range has the indented end. It is very weak. About 25 miles.

Riverside is an example of the in-between or 50-mile reception range. Its end is cut off diagonally.

If you can remember that the pointed-out range can be received farther away and the indented range, only when in close, the remaining one has to be medium strength. This will be very helpful to you if you are one of the group who has never before paid any attention to the legend page of the Radio Facility Charts.

Radio Range legs have their magnetic headings printed within their confines. Don't mess around trying to add or subtract variation. It's done for you in the magnetic heading.

Mileage in the Radio Facility Charts is *not* statute. All mileage is nautical. Also, all facilities listed in the book operate 24 hours per day unless stated differently in the "Remarks" column.

An extended range leg may mean one of two things or both but certainly *not* that the reception is better in that direction. It can denote a change in minimum en route instrument altitude (Fig. A) or reporting point intersection (Fig. B) or both (Fig. C).

Whatever the type of airport, UHF/DF or VHF/DF is available if the Radio Facility Charts show that airport's symbol with a square box around it.

The "Remarks" column will show which Air Force bases have pilot-to-forecaster service available as well as the hours and frequency for contact. This is for use in urgent necessities or emergencies only, but certainly it is wise to know where to find the information.

The USAF has available for use seven different Radio Facility Charts issued by various USAF Aeronautical Chart and Information Offices. The one referred to in this article is the U.S. Low and Medium Frequency Edition. All editions are identified by color which is usually as follows:

White book with black lettering—U.S. Low & Medium Frequency Edition
White book with blue lettering—U.S. VOR Edition
Yellow book—Pacific Edition
Red book—N. Atlantic and E. Canada Edition
Gray book — W. Canada & Alaska Edition
Blue book—Caribbean & S. America Edition
Green book—Europe Edition

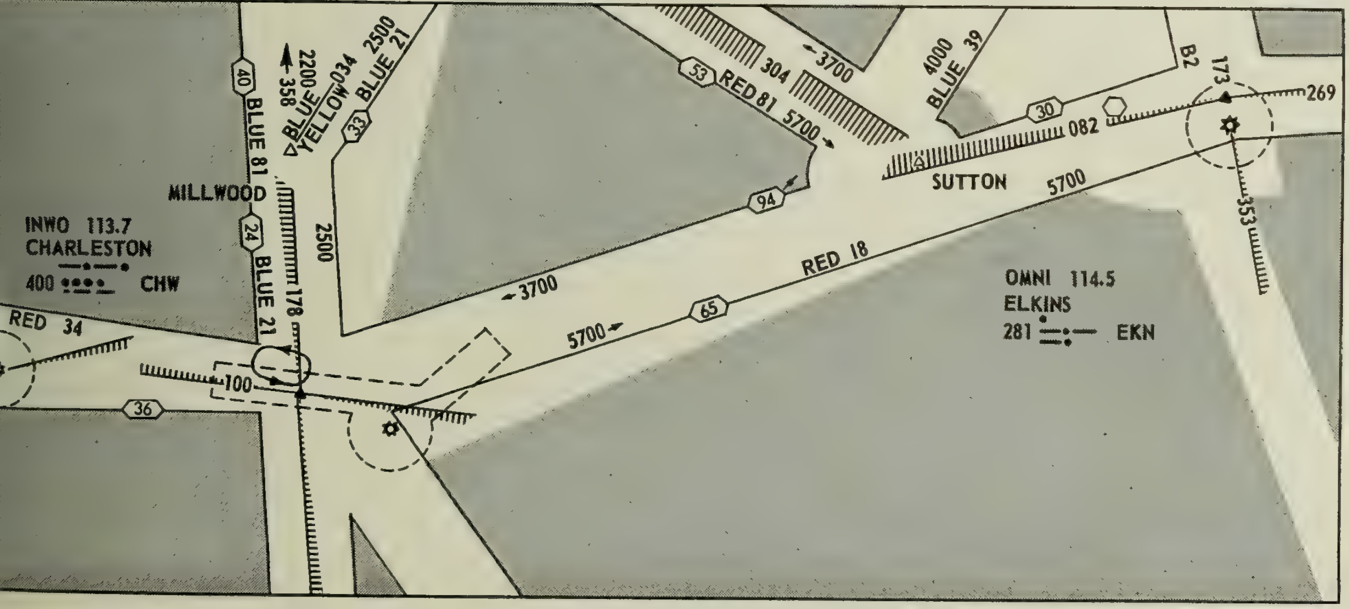
Other portions of the world, such as Africa, the Middle East, etc., are covered by the Royal Air Force and the Royal Australian Air Force in Radio Facility Charts utilized by the USAF.

Although a standardized presentation is anticipated in the near future between NATO countries and our own, there will always be some minor discrepancies in the way information is presented. Whatever edition you now utilize, study it prior to the day you're in the soup.

The U.S. Edition is printed every two weeks. It is most important for station commanders to inspect the entries covering facilities under their control in *each* edition to verify the correctness of the listings. However, should the commander or his representative miss an error, any person noting the error should report it for correction. The correct procedure for reporting errors is shown in paragraph 5b, page 1 of the U.S. edition. I recently called a USAF tower for a practice DF steer. They advised me that their DF equipment had been removed six months previously. After I told them that the current U.S. Radio Facility Charts showed their station to possess VHF/DF, they admitted ignorance of the fact but assured me a correction would be made immediately. Out of date information

**If an aircraft is not equipped to receive all navigational aids, the rule is to fly highest given minimum en route altitude.**

**(D)**



in the charts could result in serious accidents. It is everyone's duty to keep the information current.

Did you ever wonder why some civil airways carry two listed minimum en route altitudes for the same segment, such as Figure D?

Minimum altitudes are based on all radio navigational aids including radio ranges, radio beacons, VHF omni ranges, VHF VAR ranges and fan markers. In cases where an aircraft is not equipped to receive *all* navigational aids, the aircraft is required to fly at the highest given minimum en route altitude. In such cases two minimum altitudes are shown for an airway segment and the altitude applicable will be shown on the right hand side of the airway for the direction of the flight concerned.

What altitude should you request for an IFR flight?

Remember, that as a general rule, on green and red airways, eastbound flights should be conducted at *ODD* thousand foot levels, westbound at *EVEN* thousand foot levels, and on amber and blue airways, northbound flights should be conducted at *ODD* thousand foot levels, southbound at *EVEN* thousand foot levels. Outside control airways and control zones with visibility less than three miles, aircraft must be flown on the quadrantal Course System. (Magnetic.)

*0 to 89 inclusive—odd thousand.*

*90 to 179 inclusive—odd thousands plus 500.*

*180 to 269 inclusive—even thousands.*

*270 to 359 inclusive—even thousands plus 500.*

Have you ever tried to receive a radio range which should be on a certain frequency only to find another on that frequency? If you don't recognize the identification, turn to the page in your Facilities Book listing "Range Station and H Facility Index by Identification." You can find all ranges listed here by their identification and by so doing you will probably learn that your radio dial is slightly off frequency. More important, if you are lost and can get only one or two strong ranges, use this quick system to identify which station you are receiving.

SBMRAZ, BVOR. Would this apparent "gobbledegook" listed under "Class Power" of a Radio Facility throw you? Reference to the Radio Class Code Legend on page 4 of the book deciphers this as follows:

### Low Frequency Range

S—Simultaneous transmission of range signals and voice.

B—Scheduled Weather Broadcast.

MRA—Range (Adcock, vertical radiators), power 50 to 150 watts.

Z—VHF station location marker.

### VOR

B—Scheduled Weather Broadcast.

VOR—VHF omnidirectional range.

Your book contains other important information. You can find:

- The effective distance for VHF Radio Facilities depending on your altitude.
- The voice calls to each facility.
- The scheduled weather broadcast times for CAA, USAF, Navy and Canadian stations.
- VHF and UHF channelization and which service is normally set up for each channel.

Every page contains the elevation of each station and facility on that page, its call or identification, the class and power of the station, the magnetic bearing and distance from facility to field, the frequencies that are received and those which are used for transmissions, who operates the facility and all remarks which could possibly help the pilot. Among the types of remarks are such things as where to expect unreliable or "bent" range legs, interference, multiples, splits and fading of ranges and when facility will be closed down for maintenance. Whenever such information is changed between issues of the Facility Charts, NOTAMS are used to supplement this "Remarks" column.

Each and every map page in the book has two scales: one for nautical and one for statute miles. Each map page also has a note at the bottom advising where the ADIZ procedures and areas are to be found in the book. It is to be noted that the pages are not all of the same scale. Most blowup pages cover an area of about 65 to 95 nautical miles. The majority of the pages cover 125 by 140 nautical miles, while some few pages of areas where there is little information to be presented have areas of approximately 250 by 375 nautical miles.

The center page of the book contains a map of the United States with mileages between larger cities on airways. Flight Service Center locations and their telephone numbers, as well as Flight Service Area boundaries, are presented here, too.

In the rear of each book are pages listing current Airspace Restricted Areas, their number, name and state, effective altitude, time used, using agency and the pages of the facility charts where these areas can be found. "D" numbers represent Danger Areas, and "W," Warning Areas. Flights are prohibited over these areas while they are in use. "P" areas are Air Space Reservations and flight is prohibited at all altitudes and at all times.

In addition to the DF box around each airport symbol as mentioned earlier, all the DF stations in the United States are listed alphabetically in each book, usually somewhere near pages 150-152.

Radar Air Traffic Control Facilities and Procedures (including GCA) of both Air Force and Navy are likewise listed alphabetically on a series of pages following the DF page. With these pages is a definition of GCA, Air Surveillance Radar (ASR) and Precision Approach Radar (PAR). Weather minimums, GCA runways and hours of operation for each Radar Facility are listed here.

A most important part of the Radio Facility Charts in planning flights prior to submitting flight plans is the information starting at approximately page 165, entitled "Directory of Aerodromes." It is here that reference should be made to determine the type of field, the length of its longest runway and whether or not it is hard top. It lists also the type of fuel (if any) which is available, the night lighting, and the very important remarks column, giving latest information on oxygen, maintenance, jet assist starting units, whether or not official orders are required or whether the base is a foreign clearing station, etc. This section, plus NOTAMS, plus weather decides your destination prior to any flight.

A section headed "Special Notices" near the very end of the U.S. Radio Facility Charts includes:

- Requirements for clearance to and from the Washington, D.C., area.
- Emergency Radar Interceptor Procedures.
- Minimum and en route altitudes.
- Conversion from statute miles to nautical miles.

The following from the legend page of the Radio Facility Charts should also be known by all users:

| | |
|---|---|
| P/333 ▨ | **Designates prohibited areas.** |
| D/333 ▨ | **Designates danger areas.** |
| W/333 ▨ | **Designates warning areas.** |
| ▒ | **Designates ADIX zones.** |
| Ⓐ | **An Air Force Field.** |
| 🅗 | **Non-directional homing beacon.** |
| 133 | **Indicates nautical mileage on civil airways between all reporting points and/or LF/VAR radio ranges and homing beacons.** |
| 8000 | **Minimum en route altitudes are shown within civil airways.** |

Range legs are reproduced in the book in three ways:

1. ▨ **RA and RL Ranges: Reception approximately 100 miles.**
2. ▨ **MRA and MRL Ranges: Reception approximately 50 miles.**
3. ▨ **ML Ranges: Reception approximately 25 miles.**

Note the difference in their ends. This tells you something, or it should. And if it hasn't told you anything in the past, I hope it will in the future. Number 1 identifies RA and RL Ranges. The end points out. This should henceforth indicate to you that this range has better reception than the other two (in fact, approximately 100 miles).

Number 2 identifies MRA and MRL Ranges. It has a plain cutoff end and it has an *average* reception of 50 miles.

Number 3 identifies ML Ranges. Its reception is quite *weak*. Usually about 25 miles.

- Procedure for entering the New York Area.
- Fuel servicing for Naval and Army Installations.
- Restrictions in the use of AF fields and facilities.

This page ought to be studied by each pilot with the arrival of each new Facility Chart for changes and new notices.

Designated mountainous areas and Air Defense Identification Zones are presented in map form with coordinates and ADIZ names.

The back cover lists one of your most important in-flight sections of the book. The types of flight plans, how to change them in flight, position report procedures, emergency procedures and ADIZ procedures and allowable tolerances.

The outside back cover not only shows a map of where each area may be found, but also contains time zone boundaries and variation lines.

We have gone from front to back, in the Facility Charts. A few readers may have known all of this information but most of you probably learned a few facts. If you are in this category, stop by operations and pick up a copy of the latest Radio Facility Charts. Leaf through it and find examples of the items that are new to you since reading this. And then, above all, use your knowledge on the next flight and try to help promote safety through a better, more efficient use of your Radio Facility Charts. ●

*Answers to "True" and "False" questions on page 10.*

| | |
|---|---|
| **1. True** | **4. True** |
| **2. False** | **5. False** |
| **3. False** | **6. True** |

# GCA in big "K"

**By Major Geoffrey Cheadle, 1993 AACS Mobile Comm. Sq.**

THE writers of AFM 51-38, "The Theory of Instrument Flying," hit the nail on the head when they said, "The application of radar devices to the fields of instrument flight and air traffic control is apparently without foreseeable limit."

Over here in Korea the use of GCI and GCA radar has more than substantiated the above statement, while in Japan the Tokyo Radar Air Traffic Control Center has done the same. This has reversed the usual situation in which pilots are inclined to over-estimate the service inherent in a navigational aid. Now they are tending to be unaware of the *capabilities* of radar in air traffic control.

As an example, the following typical incident happened recently at one of our forward air bases.

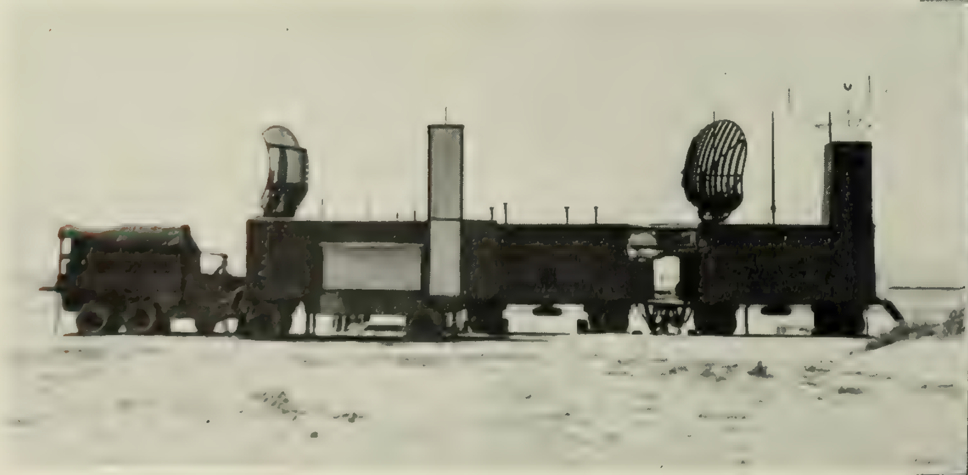
A B-29 was coming back south from a mission and was reporting low on fuel. He was being vectored under instrument conditions by a GCI radar station toward the nearest suitable base. At an altitude of 12,000 feet, approximately 25 miles out, the aircraft was picked up on the air base GCA scopes. GCA informed the pilot that they had him in good radar contact and would bring him on in if GCI would release him. The pilot refused, saying that GCA could not possibly have him on their scopes at that range and altitude, so he would continue on in under GCI control to a lower altitude at shorter range. Finally, a GCA approach and landing was made without incident. No danger was involved—this time. However, the GCI station was tied up controlling the B-29 when it was not really necessary, and should an emergency have occurred at lower altitude, the transfer of control between GCI and GCA might have occurred at a very undesirable time.

There are doubtless numerous pilots who would have had the same mental reservations about GCA as this B-29 pilot. After all, the current written instrument examination still sticks to the 25-mile and 6,000-feet limitations on GCA. The answer is that newer types of radar have been developed and are being used wherever available. The new GCA unit is the AN/CPN-4. The older unit still giving good service at most Air Force bases is the AN/MPN-1. The CPN-4 was developed to overcome certain limitations of the MPN-1, while at the same time realizing extra capabilities inherent in radar air traffic control. The big brothers of the CPN-4 are the AN/FPN-16, the AN/CPN-18 and others. These are units designed for radar air traffic control of a large area, such as the entire Washington, D. C., or Tokyo airport. A technical description of these systems for pilot use is more subject matter for the Instrument Flying Manuals (Hint!). Here, let's point out the extra service which can be given by the CPN-4 GCA unit.

The Korean effort has had a priority in getting CPN-4's. Consequently, three forward air bases here have them. At these bases they have been used to control all types of traffic, whether administrative or tactical, conventional or jet. It might be mentioned that having CPN-4's in Korea has highlighted the supply and maintenance problems which come up in keeping such an intricate and sensitive instrument operational in a combat theater. On the other hand, Korea has been an ideal proving ground for this new equipment. Nowhere else is the variety so great or are the emergencies so numerous.

We have used GCA in controlling air traffic at altitudes up to 35,000 feet and at distances up to 40 miles.

**The Korean effort had a priority in getting the newest in CPN-4 GCA units.**



*[These extreme altitudes can be obtained by proper use of antenna tilt; however, when high altitude coverage is used, some loss in coverage at very low altitudes may be experienced.]* Even the CPN-4 tech orders are not up to date on these capabilities. This long range aspect alone has accounted for literally dozens of recorded "saves" of battle-damaged aircraft or aircraft returning low on fuel. For one thing great versatility is possible in the approach track of an aircraft. Given proper radar identification, GCA can bring a jet aircraft in from GCI control onto the final approach. This was done in an emergency recently, when an F-86 reporting low on fuel was brought straight in from up North to a successful landing under instrument conditions. The pilot in this case had confidence in GCI and GCA. It was fortunate that he was not required to maneuver on the way in, because he flamed out one quarter of a mile short of the runway, just close enough to coast in safely. Saved: One F-86.

The CPN-4 also differs from the MPN-1 in scope presentation characteristics. The MPN-1 has three separate scopes: one for PPI search, one for glidepath, and one for azimuth. This requires a change of control during every run from the search controller to the final controller. It also limits the number of aircraft on final approach to one at a time. In the CPN-4 there are three bays of two scopes each. Each bay has all the capabilities of an entire MPN-1. Each has a PPI scope and an "AZ-EL" scope, the latter giving a combined presentation of glide-path and azimuth. Only one controller is needed to take an aircraft all the way through the pattern down to a landing. This incidentally confuses some pilots, who are expecting the usual transfer of control.

With three-bay operation, multiple approaches are easily accomplished. Theoretically, a constant stream of aircraft can be controlled to a landing with only one mile separation on the final approach, with an aircraft landing every half-minute or so. The advantage of this in a combat theater is obvious. Jets cannot wait around very long after a mission.

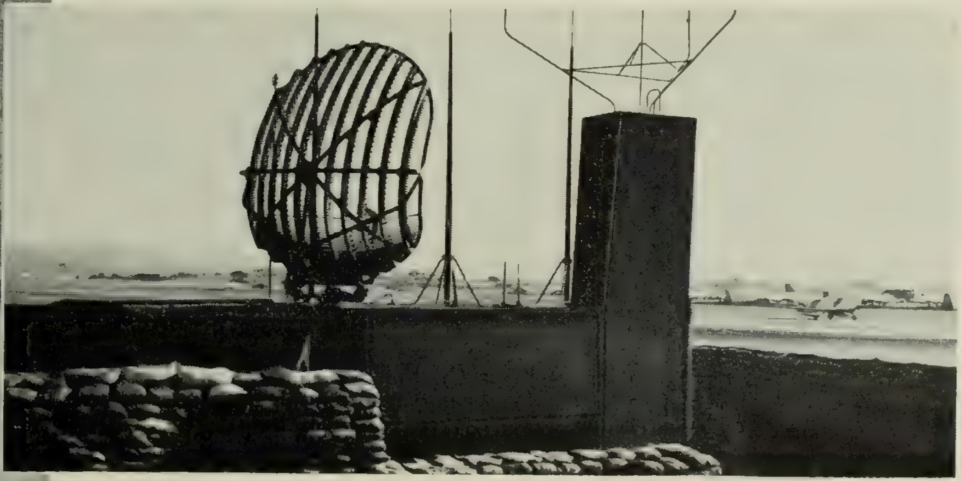
The CPN-4 has two other features to facilitate radar identification and control. The first is the AN/GRA-7 VHF/DF. This is a built-in direction-finder which throws out a strobe line on the scope to any aircraft transmitting on the frequency to which it is tuned. This provides instant radar identification (positive identification is a must at all times) without necessity of special flight maneuvers. radio fixes, etc. The second feature referred to is MTI (Moving Target Indicator). As the name implies, this device can be used to reduce in intensity all radar echoes not from moving objects. It effectively erases ground-clutter as an obstacle to full-time radar tracking of an aircraft.

Apart from new devices the CPN-4 has what the MPN-1 has, and then some. For instance, each bay in the CPN-4 has an eight-channel VHF set instead of the four-channel sets of the MPN-1. That makes 24 VHF channels available. In tactical operations where a multiplicity of VHF channels are used, this is a blessing. The larger scope faces of the CPN-4 make PPI approaches easier and more accurate. Since PPI approaches are being used more and more to provide landing into the wind or when the precision system is out, the larger scopes come in extremely handy.

*Air Surveillance Radar (ASR), sometimes non-technically referred to as "PPI" is an apparatus that can direct an aircraft to any selected runway or sea lane. The ground controller furnishes traffic direction and information for surveillance (or PPI) approaches by reference to a radar scope that shows the range and azimuth of approaching aircraft. The pilot must control his descent based on his indicated altitude in relation to the glide angle desired and the distance from the runway as furnished by the controller. The pilot must keep in mind that elevation data is not available to the GCA operator, but the controller will advise the pilot of the indicated altitude at which he should be flying at any given range from touchdown. (Radio Facility Charts, Europe, 1 July 1953.)*

*The moral of this story is that it is almost as bad for pilots to sell a navigational aid short as to over-estimate it. Let's be aware that some GCA's may be able to do things for us that we hadn't thought of. Including saving our necks. Ed.* ●

**From GCI control, GCA brings in an F-86 to a safe touchdown.**



# WING FLAPS

## FACT vs FABLE

THE pilot of today's modern aircraft usually is well trained to perform the motions required for safe flight under normal operating conditions. It is unfortunate, however, that in certain abnormal flight conditions a lack of technical understanding of the many complex installations under his command sometimes does result in an accident. It is even more unfortunate when the accident results from lack of technical understanding of such a common and uncomplicated installation as the wing flaps.

Technically speaking, the wing flap installation is a simple mechanism. Usually controlled by a simple switch or handle in the cockpit, it can be extended and retracted at any time during flight. There is nothing complicated about it . . . no knobs or levers to operate in proper sequence . . . yet, the improper actuation of this system has resulted in many accidents. The faulty use of this system in such cases is traceable to lack of technical understanding regarding the wing flap installation. Mechanically, the installation was capable of perfect operation.

Despite its basic simplicity, the wing flap is associated with a line of fallacy and folklore that will stretch from Kittyhawk to San Diego. Most of the misimpressions regarding wing flaps are directly traceable to the pilots themselves.

The wing flap was designed some 20 years ago to accomplish one purpose: to reduce speed at takeoff and landing. That's all. No fantastic performance claims such as increased lift for increased gross weights, higher rates of climb, steeper angles of climb, or any of numerous other claims. Just lower takeoff and landing speed.

*Why lower takeoff and landing speeds?*

The need for lower takeoff and landing speeds was a direct result of our prime objective in aircraft design—speed. To achieve the speeds of our modern aircraft, a reduction in airplane drag was necessary. This was accomplished largely by altering the design of the wing to reduce the induced and profile drag of the wing.

In most instances, this has resulted in higher wing-loading weight over wing area ratio. In general, however, the reduction of wing drag was accomplished by increasing the aspect ratio, decreasing the wing area, and reducing the thickness of the wing profile. The aspect ratio is obtained by dividing the square of the wing span by the wing area.

$$AR = \frac{WS^2}{WA}$$

As wing design was advanced to achieve higher cruising speeds, speeds for takeoff and landing also increased. It became evident that a wing designed for high performance flight would not be suitable for such low speeds as those desired during takeoff and landing. Many auxiliary installations such as the wing slot, variable camber, telescoping wings and other "aids" were devised and discarded due to their complexities or cumbersome weight. The ultimate design was the wing flap.

On today's modern aircraft there are many adaptations of the wing flap installation, including the plain flap, the split flap, the slotted flap and the Fowler flap. The object of the flap is to alter wing camber and/or increase the wing area, thereby assisting the wing to produce the necessary lift at a lower airspeed. An increase of the convexity of the entire wing or the wing upper surface will change the camber of the wing. The plain flap, the split flap and the slotted flap operate to alter wing camber only, whereas the Fowler flap alters the wing camber while effectively increasing the wing area. In the retracted position, the wing flap conforms to the basic wing, and therefore does not contribute to airplane drag. In its extended position it alters wing camber and/or effectively increases the wing area, making it possible to accomplish flight at low airspeeds. It is retracted for normal climb and cruising flight and extended for takeoff and landing.

The wing produces lift to offset the weight of the airplane at all times during unstalled flight. The minimum speed at which the wing is able to

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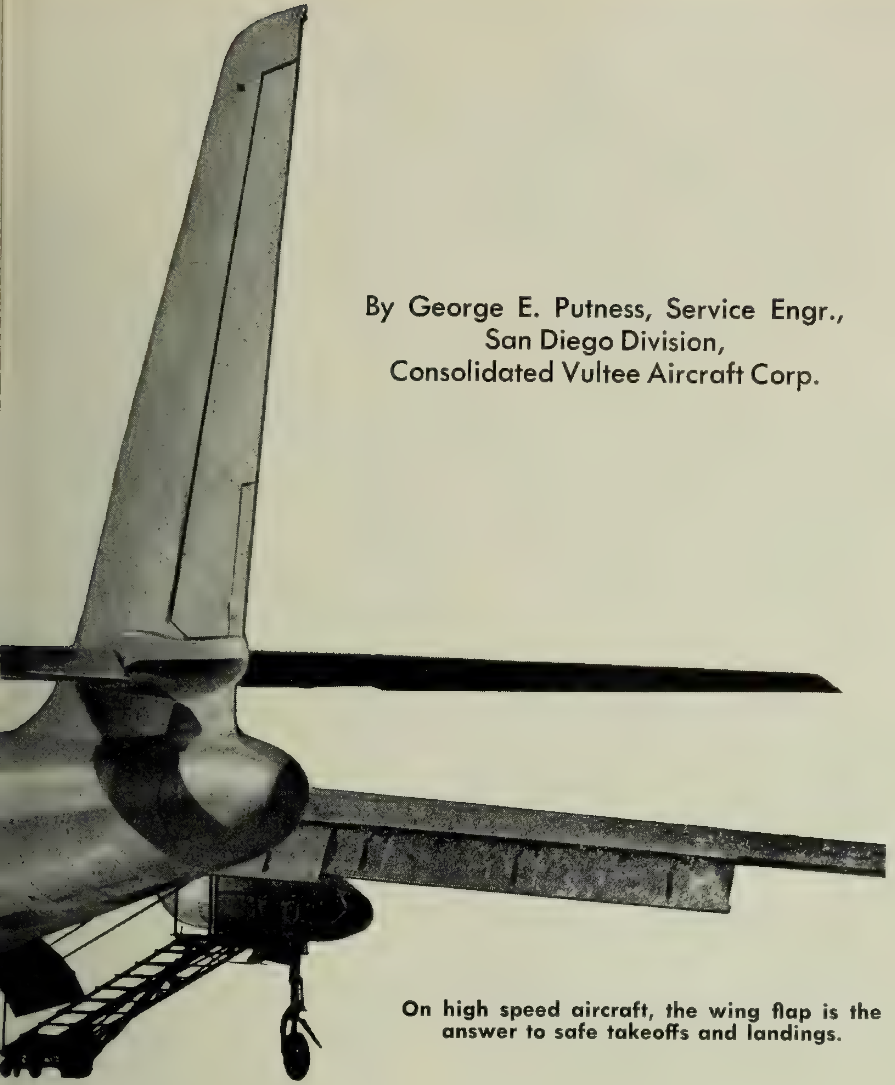


**On high speed aircraft, the wing flap is the answer to safe takeoffs and landings.**

produce lift equal to the weight of the airplane is usually referred to as the *stall speed*. The capability of the wing to produce lift is usually discussed in terms of *coefficient of lift*, a non-dimensional value. Since the wing produces lift only to counteract the weight of the airplane, it is not possible to express the capabilities of a particular airfoil section in terms of pounds of lift. The value would change as the airplane weight changed. The term *coefficient of lift*, being non-dimensional, expresses the true lift capabilities of the wing, regardless of airplane weight, and can be used in conjunction with airplane weight to determine the minimum speed at which lift equal to weight will be obtained.

$$C_L = \frac{L}{qS}$$

*Where:* $L$ = *lift in pounds*
$q$ = *dynamic pressure in pounds per square foot*
$S$ = *wing area in square feet*

However, since lift is equal to airplane weight in unaccelerated flight, the formula can be simplified for everyday use to determine the wing CL or airplane stall speed for a known CL.

$$C_L = \frac{W}{.00256\ x\ V^2\ xS}$$

*Where:* $W$ = *airplane gross weight in pounds.*
$V$ = *airplane indicated airspeed in mph.*
$S$ = *airplane wing area in square feet.*
*.00256* = *represents a constant required to utilize airplane indicated airspeed in mph.*

A wing that produces a low takeoff or landing speed is considered to have a high maximum coefficient-of-lift value. Conversely, a wing with a high takeoff or landing speed is considered to have a low maximum coefficient-of-lift value. Wings with a minimum of induced and profile drag, permitting high cruising speeds, usually are of a low maximum coefficient-of-lift value.

In order to achieve an increase in the coefficient of lift without sacrificing the desirable low-drag characteristics, it became necessary to provide a supplemental installation. The wing flap is this installation. Observe the relationship of the modern wing and wing flap to an out-dated wing design.

### Retracted Position

In the retracted position, the flap conforms to the wing contour; in the extended position, the wing area has been effectively increased and the wing camber has been altered to achieve similarity to a high-lift coefficient, low speed wing.

Since the installation of wing flaps and their operation in the extended position results in a similarity to the airfoil section used earlier and since discarded due to high drag, it also is to be expected that the increase in lift coefficient is accompanied by an increase in airplane wing drag. Operation of the airplane with wing flaps extended in any position results in increased airplane drag and decreased airplane performance.

*Why Decreased Airplane Performance With Wing Flaps Extended?*

The airplane power plant must produce thrust equal to the airplane drag to maintain unaccelerated level flight at any airspeed. Increasing airplane speed requires increasing amounts of thrust until the maximum level flight speed is attained, using the maximum thrust available.

To produce a rate of climb at a given airspeed, the thrust available from the power plant must be greater than the thrust required for unaccelerated level flight at that airspeed. This difference between the thrust required due to airplane drag and the thrust available as limited by the capability of the power plant is defined as *excess thrust*, since it can be used for added airplane performance.

The greater the value of excess thrust, the greater the airplane performance at a given airspeed. However, since the thrust available is limited by the power plant installation, any increase in airplane drag will require a greater thrust, thereby resulting in decreased performance through a lesser value of excess thrust. The extension of wing flaps to any position increases airplane drag and reduces airplane performance.

An airplane can go only so fast for

a given power and wing flap condition. If climb is desired, speed must be sacrificed and if speed is desired, climb must be sacrificed. Either climb or speed can be obtained, but it is not possible to have a maximum of both at the same time.

*Why install wing flaps if performance is decreased?*

Wing flaps are used during takeoff to achieve a low takeoff speed, resulting in a shorter ground run. Lower speeds result in decreased airplane wear and increased safety through a lesser deceleration distance if the pilot decides to abort the takeoff.

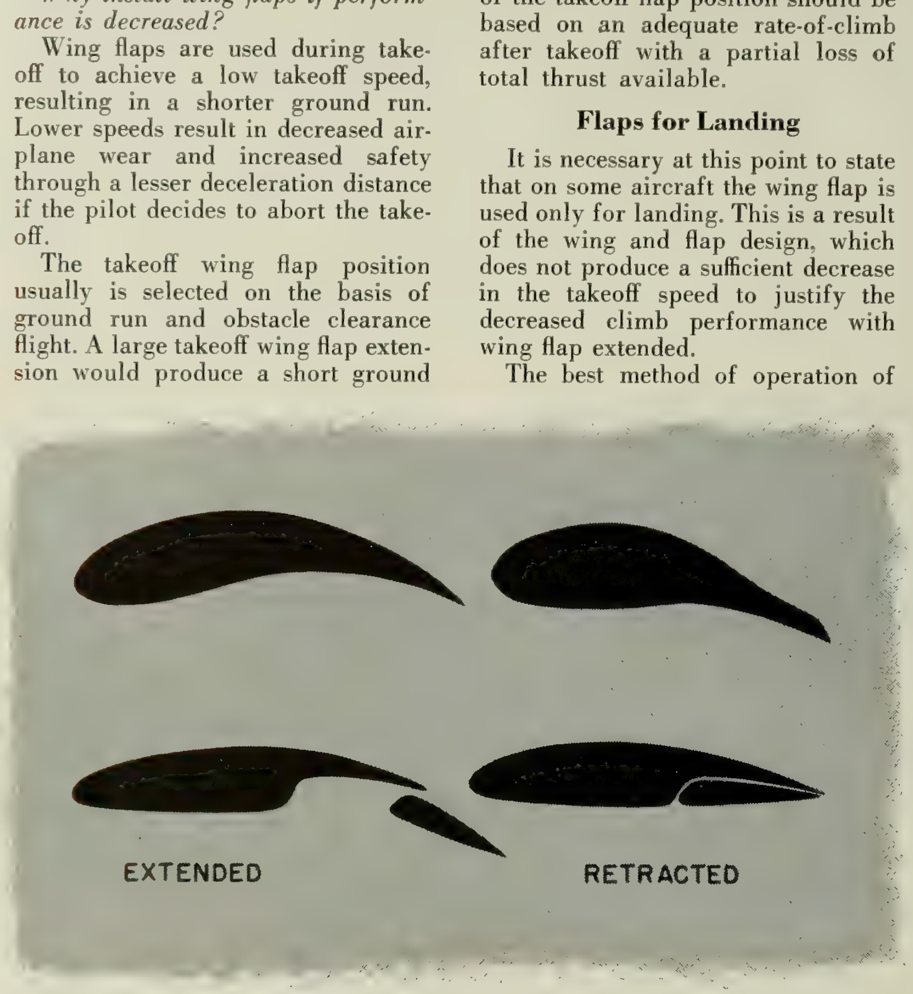
The takeoff wing flap position usually is selected on the basis of ground run and obstacle clearance flight. A large takeoff wing flap extension would produce a short ground run, but due to decreased climb performance, would not permit the aircraft to clear the immediate field obstacles. A small takeoff wing flap extension would produce increased climb performance, but, due to the increased ground-run, might require more than the available runway for takeoff. The optimum wing flap position usually is that which produces the shortest horizontal ground run to clear existing obstacles.

However, the optimum takeoff flap position for multi-engine aircraft with all engines operating may not be the optimum flap position following an engine failure or partial power loss. This is due to the loss of climb performance resulting from the partial loss of total thrust available. The resultant rate-of-climb under a partial power-loss condition may not be sufficient for safe clearance of immediate obstacles. In the consideration of continued safe flight under emergency takeoff conditions, the selection of the takeoff flap position should be based on an adequate rate-of-climb after takeoff with a partial loss of total thrust available.

### Flaps for Landing

It is necessary at this point to state that on some aircraft the wing flap is used only for landing. This is a result of the wing and flap design, which does not produce a sufficient decrease in the takeoff speed to justify the decreased climb performance with wing flap extended.

The best method of operation of wing flaps during takeoff is relatively simple — LEAVE THEM ALONE!



Shown here is a comparison of a modern wing and wing flap with an outdated early wing design and flap.

Due to the substantial decrease in wing coefficient-of-lift, the retraction of the wing flaps may prove disastrous. The wing flap position should not be altered during takeoff until two details have been accomplished:

- *All immediate obstacles have been cleared and the airplane has reached a safe altitude.*
- *Airplane nose high attitude has been decreased and airplane speed allowed to increase to the "flaps-retracted" climb speed.*

The airplane rate-of-climb will be reduced during the period of acceleration to the flaps-retracted climb speed, because the total thrust available can be used for acceleration o climb but not for a maximum of both simultaneously. In some instances the wing flaps may be retracted i increments, using the rule-of-thum of one degree for each one mile-per hour increase in airspeed above th particular flap position climb speed

However, the wing flaps shoul never be retracted without first allowing the airplane to accelerate to a saf speed. At low airspeeds, the flaps ar depended upon to sustain flight. I flaps are retracted at low airspeeds the airplane may stall and lose altitude. Until the airplane rate-of-clim can be sacrificed to allow acceleratio to the flaps-up climb speed and maximum rate-of-climb, a better rate-of-climb is obtained with flaps.

The wing flap position during landing is usually fully extended, sinc in this position the airplane can sustain flight at the minimum speed possible, and can approach the landing in the steepest angle of descent.

*Why a steep angle of descent and minimum speed for landing?*

The steeper the angle of descent during landing approach, the less horizontal distance will be required for the descent to touchdown. This means that where obstacles are in the immediate vicinity of the runway, a greater portion of the runway will be available for the landing roll.

The lower the speed for landing, the less distance will be required for the deceleration roll, thereby permitting landings on relatively short runways. The low landing speed also reduces tire and brake wear.

The extension of wing flaps to the fully extended position for landing should not be accomplished until it is certain that the landing can be completed. Otherwise the increased airplane drag, due to the wing flap position, and a partial loss in total thrust available, may not allow a wave-off and go-around.

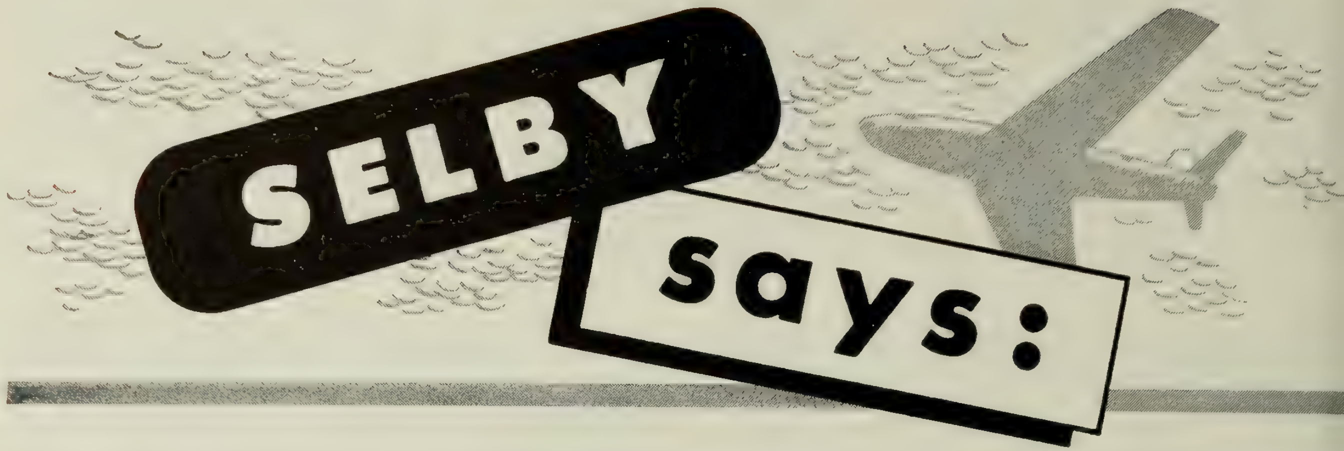
In summation, we can state that the wing flap mechanism is installed to provide low takeoff and landing speeds, thereby resulting in short ground distances for takeoff and landing. After takeoff and acceleration to a safe flaps-retracted speed, the flaps should be retracted and further use restricted to the approach for landing and landing. Any extension of the wing flaps during normal climb or cruising will result in loss of performance, and therefore should not be attempted. ●

# WELL DONE!

**To the pilots and crews of the Fifth Air Force, *FLYING SAFETY* extends a particularly hearty "*Well Done*" for the outstanding role they played in the Korean action.**

**And a "*Well Done*" to the men who stayed on the ground, that the pilots and crews could safely accomplish the mission of the United States Air Force.**

TO THE B-26'S, THE F-51'S, THE F-80'S, AND THE F-84'S... ....A WELL DONE!
...TO THE MIG-KILLERS, A WELL DONE!
TO AIR RESCUE, A WELL DONE!
RESCUE
TO THE MOSQUITOS ...A WELL DONE!
TO SAC..... A WELL DONE!
TO MATS AND TROOP CARRIER ... A WELL DONE!



***Our weather experts know their business as you will see after reading this article.***

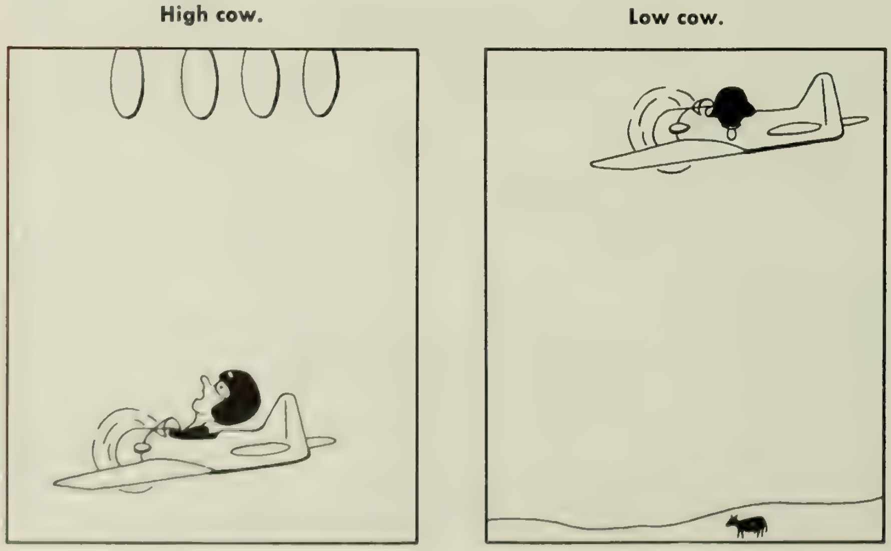
# WEATHER OBSERVATIONS and the LANDING PILOT

### By Operational Analysis Division, Headquarters, Air Weather Service

*"It's all in the point of view" . . . but regardless of how you look at a cow, it's the end result of an ice-cold glass of milk and a rare beefsteak that counts. (See "Slant Range Visibility,"* Flying Safety Magazine, *May, 1953.) I wonder what Air Research and Development Command has to say about "built-in windshield obscuration."*

Selby

"IT'S ALL IN THE POINT OF VIEW."

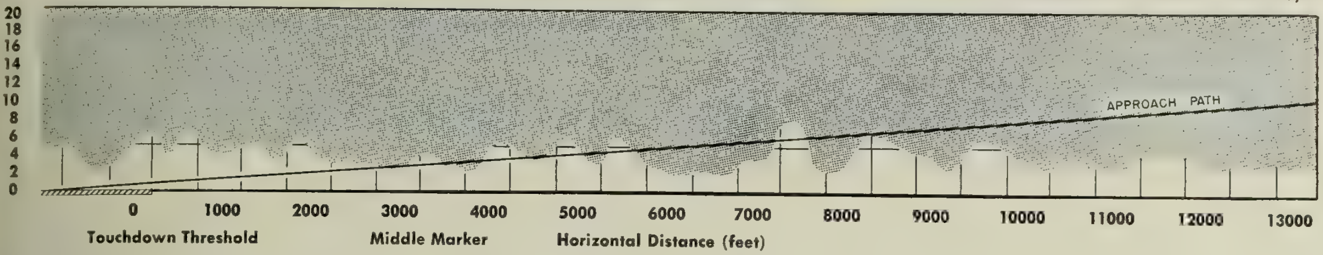

**High cow.** **Low cow.**

THE Old-Timer was sitting on his porch, rocking gently. "You know," he said, "what you see and how you figure what things look like depends a lot on where you are. Ever look up at the under-side of a cow? Craziest thing you ever saw! But stand off and watch it, and it's a mighty nice-looking critter!" *(See cartoon, "It's All in the Point of View!")*

Remember the times when you, a pilot, came in to land during bad weather, and ran into ceiling and visibility conditions that were "different" from the weather report given you by the tower? You're a reasonable man, you know the weather people, like them . . . but this was too much. You can understand why the weather men will occasionally "bust" *forecasts.* After all, there's plenty they still don't understand about what makes the weather tick. But this business of *observations* is different . . . seems as how the weather guys can't even tell what weather they've got *right now!*

Incidents like the above have occurred with increasing frequency over the last five years. Why? . . . we suspect it's because the operating margins for landing aircraft have been shaved thinner and thinner. In the old days, if the pilot could see the airport from altitude, he landed . . . if he couldn't, he didn't. Now, how-

Fig. 1. Cloud Base Contours



(COURTESY U.S. WEATHER BUREAU)

ever, instrument landing aids can bring the pilot blind to a minimum altitude, by which time he must have transitioned to visual reference. The requirements of an all-weather Air Force and the ticklish business of landing high-speed jets in bad weather have increased the pressure on the weather observer to more precisely report landing ceiling and visibility conditions.

The cry of "Report what the landing pilot will see!" has become increasingly popular. Another one the weather man hears is "Don't give me gobbledegook . . . just tell me at what point on my glide path I can see the runway!" This is not easy to do.

### Campaign Started

In view of the heat generated on this subject (there's been some light, too), Air Weather Service has started a campaign to bring AF personnel up-to-date on where the weather man stands with respect to this problem. Some questions of interest to flying personnel are:

☆ How well can the weather people actually determine the ceiling and visibility conditions that the landing pilot will encounter?

☆ What are the weather people doing to improve their capabilities in this direction?

☆ Are there any tricks-of-the-trade that pilots can use to get around the difficulties created by the weather man's limitations in this direction?

Let's tackle the first question . . .

How far you can see through the atmosphere depends on four factors:

- The properties of the atmosphere itself. For example, presence of condensed water vapor in the form of clouds, occurrence of dust particles, and so on.
- The amount and distribution of light; "how much" and where's it coming from?
- The kind of objects at which, or for which, you are looking. You can't tell how far you can see unless you're looking at something!
- Your visual ability. And in the pilot's case, this includes the extent to which his vision is hindered by poor cockpit and windshield design and other structural characteristics of the aircraft.

The first two factors above are *meteorological,* and it is the weather man's job to measure and report them. He does this by sight, or, what is much better, by a combination of sight and weather-measuring instruments. The ceilometer, which measures the height of a cloud base over a point, and the transmissometer, which measures the transmissivity of the atmosphere between two points (this is a new piece of gear about which you'll be hearing more shortly), are examples of weather-measuring instruments that help the observer. For the rest of this discussion, when we refer to the weather man's observations, we mean his visual observations *aided in so far as possible by instruments.*

## Weather Reporting Factors

Factors that keep the weather man from reporting to the pilot just what he will encounter on final approach:

☆ Weather observer can't get a visibility measurement along the glide path; nothing to sight on. Even if he could, the measurement would differ from the pilot's visual range because of opposite direction of sighting.

☆ Pilot's vision is affected by his landing speed (particularly when precipitation is occurring) and by the structural characteristics of his aircraft. On the other hand, the weather observer and his meteorological instrument are stationary, and his vision is not restricted by an enclosure.

☆ When ceiling- and visibility-measuring instruments are not available, the weather observer's estimate of ceiling and visibility can vary between wide limits.

☆ Rapid variation in ceilings and visibilities are possible during bad weather. This changeable character is apparent from point to point at an airport and from minute to minute at one point. This variation is particularly great during on-and-off precipitation.

Now it is important to note that the last two of the four factors above are of a *psycho-physiological* nature . . . (so help us, that's what the doc told us!). Stripped of mumbo-jumbo, this means that these factors depend on *who* is doing the looking and *what* he's looking at. And brother, these last two factors present a big headache to the weather man.

### Differences

Let's talk now about the differences between the weather man's and the pilot's estimate of ceiling and visibility . . . first, the differences due to meteorological factors. Often the base of clouds in the approach zone is ragged and uneven. This means that as the cloud ceiling moves over different observing points, measurements of its height may vary considerably from moment to moment and point to point. Similarly, smoke, fog, and haze concentrations vary over an area as large as an air base.

When weather conditions approach landing or takeoff minimums, *such variations in ceiling and visibility* are often of greater operational importance than the ceiling and visibility values themselves.

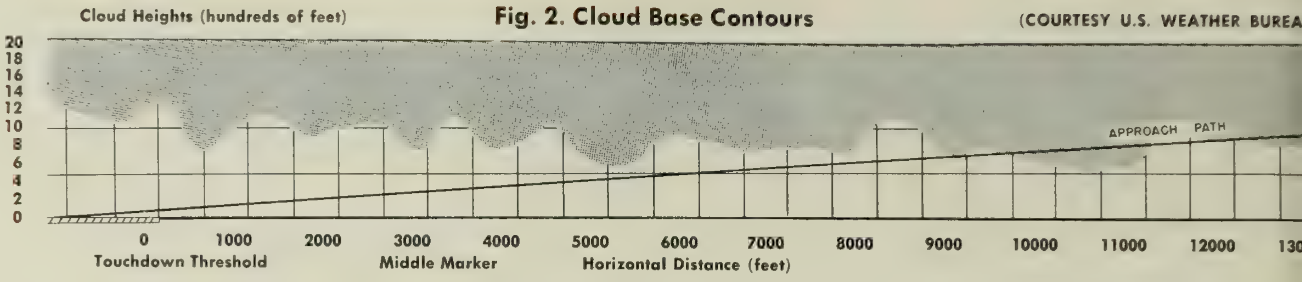
Here are examples that illustrate how great these variations can be:

1. In a joint CAA-CAB-U.S. Weather Bureau-Air Transport Association test at the Washington National Airport, Washington, D. C., August 1949 to March 1950, ceiling and visibility observations were taken simultaneously from the terminal building and from a runway site about 3,000 feet away.

RESULTS: Ceiling observations between the two points varied 100 feet or more in 61 per cent of the observations and 300 feet or more

**Fig. 2. Cloud Base Contours**

(COURTESY U.S. WEATHER BUREA



in 12 per cent of the observations. Visibility observations varied by ⅛ mile or more in 70 per cent of the observations and by ½ mile or more in 25 per cent of the observations!

2. A similar test was conducted by Air Weather Service at Manston, England, in March and April 1952. The base weather station and the runway observing site were about ⅝ mile apart.

RESULTS: During the time the field was below VFR by reason of the base weather station observation being below 1,000 and/or 3, *about 20 per cent* of that time the runway site reported *above* VFR landing conditions. Furthermore, during the time the field was below GCA minimums because the weather station observation was below 300 and/or ½, *about 6 per cent* of that time the runway site reported *above* GCA minimums.

The conclusion is striking . . . ceiling and visibility measurements during bad weather depend a lot on where the observer or the observing equipment stands! It is worth noting, too, that on a GCA run, the aircraft is more than two miles away from touchdown when it's at 500 feet altitude.

3. Figures 1, 2 and 3 come from a recent test made by the U.S. Weather Bureau in a project sponsored by the Air Navigation Development Board. The cloud height measurements were made with a rotating-beam ceilometer, which can record a measurement every 24 seconds. The instrument was located at a fixed point, and the time variation in cloud height translated to a space variation for illustrative purposes.

These figures illustrate the "in-and-out" characteristics of an approach during low, variable ceilings. In Fig. 1, for example, the glide path would be "in" clouds 7500 feet from threshold, "out" at 5200 feet, "in" at 4900 feet, and so on, until final break-out about 2500 feet from threshold.

The implication of this data is clear. Under bad weather conditions, ceilings and visibilities can vary markedly over fairly short intervals of space and time.

Now what about the difference between the weather observer's and pilot's estimate of ceiling and visibility, due to psycho-physiological factors? Here, we are mainly concerned with how far the pilot expects to see obliquely from the cockpit and down the glide path.

Ceiling and visibility vary as much for the pilot as they do for the weather man on the ground . . . the pilot is just moving too fast to notice it. The incoming pilot is primarily concerned with seeing details in terrain or objects of recognition near the runway. His ability to pick out these objects is determined mainly by "object contrast," which means how much the object differs from and stands out from its background. When his windshield is swept by rain or snow or coated with ice, the pilot may not be able to see objects 100 feet away although the actual visibility may be as much as three miles. Furthermore, when he is tired or unfamiliar with the landing field, his ability to see some object on the ground and to know his distance from it is greatly reduced.

The human weather observer isn't perfect, either. We know from rece experiments, for example, that se eral weather observers can differ several hundred feet in their estima of a ceiling height that was ma without measuring instruments. T "human equation" influences the o server's estimate as well as the pilot

### What Can Be Done?

So much for the factors affecti the observer's ability to see and t pilot's ability to see. . . . Is it a wonder they often report differe ceiling and visibility values? We you'll ask, what can be done abo these difficulties? . . . you've got fly . . . you can't tell the "old man "Sorry, Chief, count me out. T whole area's reporting ragged ce ings near minimums, and since t weather observer can't give me on-the-button reading, I think I stay in the sack today!"

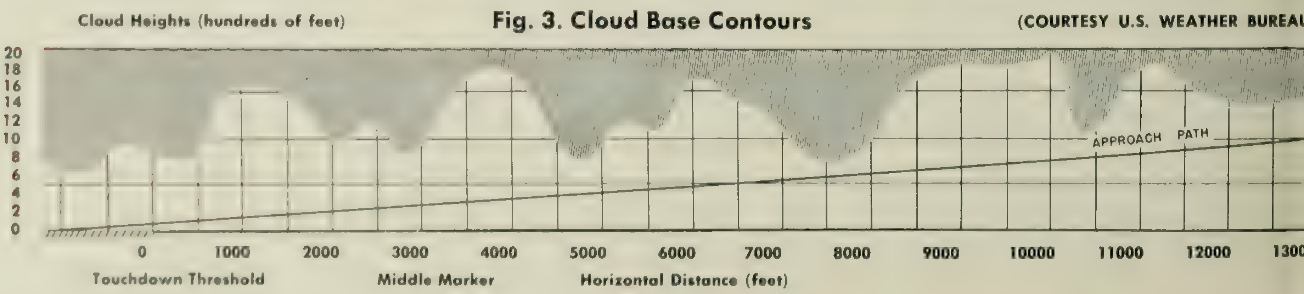
First, let's talk about what the A Weather Service is doing.

The way the AWS sees it, the pro lem is for the weather observer duplicate as nearly as possible t situation in which a landing pil finds himself, and then to observe t ceiling and visibility in that situatio in which a landing pilot finds hi self, and then to observe the ceili and visibility in that situation.

At present, at air bases where t base commander concurs in the nee a weather observer stations himse near touchdown when the weather bad. He observes visibility down-ru way and out into the approach zo and also the height of cloud base. T purpose is to minimize as much possible the spatial and time vari

**Fig. 3. Cloud Base Contours**

(COURTESY U.S. WEATHER BUREA



## Slant Range Visibility

A word here about "slant range visibility," a term used to describe how far the pilot can see down the glide path. The value of such a measurement is obvious . . . If a pilot is landing at 120 mph and his slant range visibility is two miles, then he'll see touchdown one minute before he gets there . . . at least that's what the formula says.

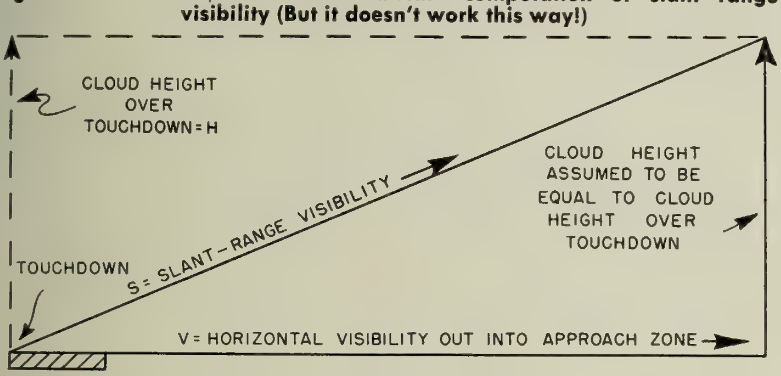
In the beginning, the mathematicians decided the simplest way to get slant range visibility was to measure the ceiling height at touchdown and the horizontal visibility in the approach zone, and compute the slant visibility using the trigonometry shown in Fig. 4.

The one fact that shoots holes in such calculations of slant range visibility is that the physical properties of the atmosphere within the glide path are often different from the physical properties of the atmosphere where we're measuring cloud height and visibility.

Such indirect measurement of slant range visibility, that is, where measurements of other visual ranges are made and the slant visibility computed from them, hasn't given us the answer.

How about *direct* measurement of slant range visibility? Well, we might suspend, in the approach zone, targets to sight on. The British have tried mooring balloons near glide path to give the observer on the ground something to look at. They've also experimented with firing rockets aloft to provide sighting targets. The operational hazards involved, however, are considerable. We would guess that if a gadget is ever made to measure this thing directly, it'll be a type of light extinction meter such as a photographer might use to give him the proper lens opening and shutter speed for a picture.

**Figure 4. $S^2 = H^2 + V^2$. "Mathematical" computation of slant range visibility (But it doesn't work this way!)**


CLOUD HEIGHT OVER TOUCHDOWN = H
CLOUD HEIGHT ASSUMED TO BE EQUAL TO CLOUD HEIGHT OVER TOUCHDOWN
S = SLANT-RANGE VISIBILITY
TOUCHDOWN
V = HORIZONTAL VISIBILITY OUT INTO APPROACH ZONE

tions in ceilings and visibilities discussed before.

In addition, AWS is carrying out a long range program aimed at taking ceiling and visibility observations by electronic instruments (like the ceilometer and transmissometer) located on the ground in the approach zone near touchdown. Remember, however, that we cannot suspend the instrument on the glide path; we cannot skid the recording instrument down a 2½° glide toward touchdown to simulate the experience of the landing aircraft, and we cannot adjust the instrument to take into account pilot fatigue, pilot familiarity with the terminal area, and other psycho-physiological factors.

In short, there are angles to this problem that the weather man can never solve.

Another thing AWS is doing is monitoring closely the attempts to solve this problem by such U. S. agencies as the NACA, CAA, ANDB, Weather Bureau and by foreign meteorological services. Let's not kid ourselves . . . this problem has most of the world's weather services and flying organizations hopping. The first Air Navigation Conference of the International Civil Aviation Organization was held in Montreal in February and March 1953. *The first item* on the agenda was slant visibility measurements and measurements of height of base of cloud in the vicinity of airdromes.

The conference decided that pilots landing in bad weather needed the following information:

☆ Altitude at which they would "break out" in the approach zone.

☆ Slant range visibility down the glide path and obliquely in other directions from the cockpit.

☆ Horizontal visibility down the runway.

☆ Prevailing visibility in the terminal area.

The meeting further concluded that, of these requirements, only the last two could be satisfied right now by any of the world's weather services.

American airmen have a reputation for ingenuity. Is there anything the pilot can do to make up for these limitations of weather observations? At the risk of being told to get back into the weather station where we belong, here are a few suggestions:

☆ First and foremost, recognize the limitations of observations of ceiling and visibility when they are used to estimate what the landing pilot will see. Remember, whether the observer is at the base weather station or standing in the approach zone, he *never tries to give you a bum steer* on terminal weather conditions. We're not asking you to learn weather observing, but simply to recognize the limitations involved.

☆ When you hear such terms as "indefinite," "variable," "obscured" used to describe a weather observation, be on guard for unexpected ceilings and visibilities. When a weather man reports "Indefinite ceiling, 1500 feet, obscured, 2½ miles visibility in light snow," the words that should ring a warning bell are "indefinite" and "obscured!" "Indefinite" means "not definite," "variable" means "changing" . . . so heads-up flying is in order.

☆ Recognize how very changeable the approach zone and runway ceilings and visibilities can be in bum weather. And this rapid fluctuation is greater the worse the weather. When you hear "2000 and 4 in light fog," or "1200 and 2 in rain," just remember that at some place in the approach pattern, *where the observer or measuring instrument is not located,* the ceiling and visibility can be a lot worse. ●

IT isn't the landing roll that hurts—it's the sudden stop at the end of a runway that does the damage. And avoiding this sudden conflict with Newton's law by bringing an airplane to a stop before the end of the runway is reached after landing is a problem that confronts some pilots every day.

This is particularly true during periods of limited visibility, or when runways are short, wet or icy. At these times a pilot should know the best way to stop the landing roll short of retracting the gear or removing a section of Farmer Brown's fence.

Despite the fact that the majority of airfields have adequate runways and clear approaches, a great many pilots, according to stacks of accident reports, just can't seem to make it onto the first third of a runway.

Take the case of the Gooney Bird pilot who was determined to touch the gear on the first few feet of the runway and landed ever so short—the plane stalled out and landed hard enough to knock most of the gear off.

Causes of landing accidents include water on the runway, snow, crosswind and the pilot's inability to maintain directional control. In the majority of the accidents where weather factors were listed, the pilots concerned failed to maintain control because they counted on the brakes to hold. Braking action on wet or snow-covered runways frequently aggravates a skid rather than stopping it.

Some landing incidents and accidents have been caused by a cushion of water under the tires which, it is claimed, largely nullifies good braking action.

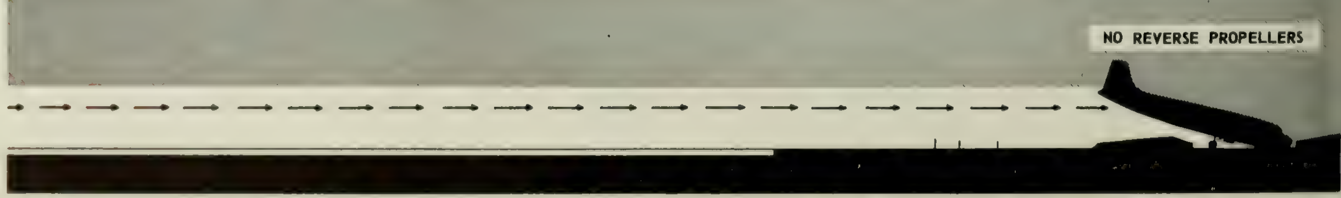
Every landing on wet or snow-covered runways presents an individual problem and the pilot should be doubly alert for the unusual that could happen. Some problems are common to all slick-surface landings—such as landing straight ahead without drifting and maintaining directional control with the rudders as long as possible.

Braking action can be even mor treacherous when only patches o water or ice remain on a runway. Under these circumstances if brakes ar applied when the wheels are on slick spot they will have little effect and if they're still being held whe a dry spot is reached, the brakes ma grab and veer the plane sharply. O course, any power used for directiona control will increase the landing roll

A few landing-roll accidents ca always be chalked up to "touch an go" practice. During practice landings in some types of airplanes i may be necessary to retract the flap before breaking ground on subsequent takeoffs. Again, under some circumstances due to weather, field conditions and type of aircraft, flap should be retracted soon after landing. Except for these, some genera precautions may be followed:

- During the landing roll do no attempt to raise flaps. Wait until yo have turned off the active runway.

# Stop IN TIME!


SAFE STOP WITH REVERSE PROPELLERS
NO REVERSE PROPELLERS

**Power is best for keeping directional control — and for stopping if your airplane is equipped with reverse pitch propellers. The brakes, when used to slow the landing roll on slippery surfaces, should always be applied gently and cautiously. Right, a B-47 stops with aid of a drag chute. At light landing weights chute is not needed in a careful approach to long runways.**

- Look at flap control lever before moving it.
- On take off, retract the gear only after you're sure safe flying speed is attained.

Power is the best method of keeping directional control. Brakes, if used during the landing roll, should be applied gently and cautiously. On airplanes equipped with reverse pitch props, reversal is the safest and most efficient means of rapid deceleration on slippery surfaces.

The drag 'chute used in slowing the landing roll of the really hot stuff—like the B-47—is an effective and comparatively late wrinkle. In this type of aircraft, the safest landing is one in which the rear gear touches first. This allows an adequate flare and prevents a bounce.

At light landing weights with runway lengths ten to twelve thousand feet, the drag 'chute is not needed if the approach has been carefully planned. Using the drag 'chute produces a 300 per cent increase in the drag of the aircraft. It is most effective at the higher speeds.

### Training Planes

Among training aircraft, the T-6 stays out in front—in the landing accident picture. Most of the T-6 landing errors come about as failures to follow the correct techniques. This is often based upon the pilot's lack of familiarity with the airplane and his apprehension over landing.

A fast glide in the T-6 will frequently cause the round-out to be delayed too long. This, in turn, necessitates an abrupt round-out which will cause floating and ballooning. Landing from this type of approach will usually be main gear first, and such a round-out may result in failure to hold drift correction. The drift is difficult to notice in such a tail-high attitude.

The degree of flaps to be used is a controversial matter and based primarily upon personal experience and opinion rather than on a hard and fast SOP. However, the normal landing for a T-6 calls for full-flaps. With a crosswind, the flaps should not be used to the extent that the slip method of drift correction cannot be used to control the drift.

Weight of the airplane is a factor, since a lighter airplane will have less weight on the wheels if angle of attack on landing is not reduced. Thus, skidding might occur with lightly loaded planes at lower speeds than would occur on heavier loaded airplanes. A heavily loaded airplane has increased landing speed and kinetic energy and, consequently, will require more braking action. Reducing the angle of attack and fast retraction of flaps will be of assistance in this case also.

The higher the airport, the higher the landing groundspeed, even though the stalling airspeed is the same. Faster landings mean more kinetic energy must be dissipated.

The effect of CG is only in relation to how much weight is on the main gear for braking action. The worst

***Everything which goes up has gotta come down***
***And if it's an airplane it should come down safely***

Reverse pitch props are a real boon when it comes to stopping the landing roll of a heavy airplane like the B-36.

conditions are a forward CG on tricycle gear and a rear CG on tailwheel airplanes.

One of the most important items in estimating the distance required for landing is the coefficient of friction. For example, the coefficient of free-roll friction on rough concrete is approximately .05 and is increased by proper use of brakes to approximately .70 for wet and .80 for dry pavement. In other words, by proper application of brakes, a pilot can almost lock the wheels but still let them roll so that they aren't skidding. In this manner, stopping of the airplane is facilitated 14 times faster for wet runways and about 16 times faster for dry pavement.

Items of importance which can change required landing distances by as much as 100 per cent under the worst landing conditions include: Landing speed slow, within safe limits; weight on the wheels—for maximum efficiency of brake, reduce aerodynamic lift.

Remember: Altitude of airport—increases landing ground speed. Wind velocity and direction — may aid or hinder slowdown, depending on use. Up-slope landing is an important aid, down-slope landing a detriment, high temperatures cause excessive landing roll.

The pilot should keep in mind that reducing the angle of attack quickly on landing and retracting the flaps reduces the aerodynamic drag as well as the lift. This causes more wear on the brakes in order to get the benefits of a shorter stopping distance. In ordinary landings where emergency stopping is not a factor, it would be better to use the aerodynamic drag available (flaps and high angle of attack) when conditions are favorable.

Here are some suggested aerodynamic techniques which should help you make safer landing rolls:

- Reduce the lift of the wings; retract the flaps immediately on contacting the ground; decrease the angle of attack by keeping the tail high on airplanes with tailwheels and by putting the nosewheel on the ground quickly on tricycle gear aircraft. Research has indicated that increasing the weight on the main gear is more important for quick stopping than the aerodynamic braking of flaps and a high angle of attack.
- After touchdown, approach the point of incipient skid when braking an airplane, but don't skid the tires. The maximum effective use of the brakes is accomplished in this way.
- Your touchdown speed is important and, when the runway is wet or slippery, the lowest speeds consistent with a safe approach are the best landing technique.

As usual, those words "pilot error" top the list of landing accident causes. Cold, statistical facts show that the odds are better than two to one that if you have an accident it will happen while you're making an approach or landing. Don't relax during this final phase of your flight. Be forewarned and forearmed and look to your own technique for bringing a plane to a safe stop while still *on* the runway. ●

**Average Stopping Distance with Reverse Thrust Propellers**

(Ground roll distance in feet from point of touch down to stop)

| Airplane | Max. Wgt. (lbs.) | Touch Down Speed (MPH) Ave. | Brakes Only | Reverse Props Only | Emergency Stop Full Brakes & Props (Ave.) |
|---|---|---|---|---|---|
| C-46 | 45,000 | 90 | 2500′-3000′ | 1800′-2000′ | 900′ |
| C-54 | 87,000 | 100 | 1500′-1700′ | 1400′-1600′ | 1000′ |
| C-82 | 60,000 | 100 | 1150′-1250′ | 1800′-1900′ | 850′ |
| C-121 | 93,000 | 100 | 1600′-1700′ | 1500′-1600′ | 1000′ |

# CROSS FEED

## LETTERS TO THE EDITOR

### One Full, the Other Empty!

During Flying Safety Meetings conducted by this command, the question has come up as to what action to take in F-94-B type aircraft when one of the drop tanks has failed to feed and it will not jettison.

Based on the known experience of pilots who have made landings in the configuration of one drop tank empty, and the other containing approximately half fuel, it is believed that it would not be possible to keep the aircraft straight after rudder control had been lost if a landing were made with one tank full and the other empty.

We will appreciate any information and recommendations your headquarters has on this subject.

**Capt. Stanley K. Haggerty**
**Hq. 10th Air Div. (Def.)**
**APO 942.**

*How about some comments from the field?—Ed.*

* * * * *

### Flying Safety Record?

As there is a certain tendency within the human race to "blow your own horn," we are coming in with this little plug. In the conventional section here at the USAF Instrument Pilot Instructor School, we have compiled over 50,000 B-25 flying hours without a pilot error accident. In fact, the only incidents during this period resulted from slight structural damage caused by hail and lightning.

This achievement may be particularly significant as this flying was accomplished under any and all weather conditions. Until restricted recently by AFR 60-16 we had no weather cancellations or postponements during this period. Incidentally, the airframes of our aircraft average 5,484 hours each. It can be easily seen that these B-25's are no longer kids.

**Maj. Terry R. Barton**
**3550th F. T. Squadron**
**Moody AFB, Ga.**

### RAF Looks for Flying Safety

I have been the USAF Exchange Officer here at the RAF Control Fighter establishment for the past two years. One of the units on the station is the Fighter Command Instrument Training Squadron, comparable to our instrument school at Moody.

During the course of my tour the people of the Instrument Training Squadron have been most interested in obtaining every copy of FLYING SAFETY, as many of your features tie in closely with their operation.

**Maj. Jackson Saunders, USAF**
**Air Exch. (OAA)**
**RAF Sta. West Raynham**
**Norfolk (U.K.)**

* * * * *

### More Anent Le Rhone

In Cross Feed of the June issue of FLYING SAFETY, you very properly removed the Gnome from the Spad but you install it in the Nieuport where, I am afraid, it does not belong. Some of us youngsters in No. 60 Squadron, Royal Flying Corps, in 1916-17 were very proud of the Nieuport Scout which had the Le Rhone, nine cylinder, 110 H.P. rotary.

My real reason for venturing this comment is to take the opportunity of expressing my high regard for the quality of the material you publish and to mention that FLYING SAFETY is studied with interest at these Headquarters.

**R. C. Kean**
**Inspector of Accidents**
**Accidents Investigation Br.**
**Royal Australian Air Force**

*At last an Old Hand to the rescue. Our two previous advisors on this technical problem were paternal gleams when Mr. Kean was flying Scouts—Ed.*

### You Wuz Right, Baby!

I just read the first article in your July issue, "Hit by Hail," and was looking at the picture of the wing that was supposed to be on a C-47.

I would like to say that if that aircraft is a C-47 they have certainly modified the old "Gooney Bird" since last I worked on one, as I never saw a single strut landing gear or wheel well doors on the old girl. The plane in the picture looks like a C-46 to me. Am I right?

I want to say Thank You for your fine magazine.

**T/Sgt. Walter Jones**
**3585th Maint. Sqdn.**
**Gary AFB, Texas**

*The Sergeant is so right. Our cutline writer has just received 100 lashes with an old pitot cover.—Ed.*

* * * * *

### What? No Screwdriver?

What ever became of the lowly screwdriver? Nothing is more aggravating to a fighter pilot who has baggage, down lock pins, form 1, etc., stuffed in every nook and cranny, than to arrive at an air base and find the alert crew sans a screwdriver.

Aircraft manufacturers are finding more and more uses for Dzus fasteners and to date no substitute for the "Dzus opener" or screwdriver has been found. Coins, dog tags, keys, etc., may accomplish the task but also damage the fasteners and harass the individual attempting to use them.

I, for one, believe that in addition to the sharp-looking white coveralls, various arrival and servicing forms for pilots to fill out, an "alert" alert crew should have at least one screwdriver available to aid a pilot in debarking his aircraft.

**Capt. Robert A. Garrison**
**FSO, Hq. 4706th Defense Wg.**
**O'Hare Internat'l Arpt., Ill.**

# Keep Current

## NEWS AND VIEWS

• **Stuck to the Pavement** — The F-86 jockey was taking off number two in an 18-ship formation. As he hit 110 knots, he tried to pull off, but she just rolled and rolled. Takeoff was aborted, tire blown. Inspection revealed that the pilot had not checked the clearance of his oxygen hose and G-suit connection in relation to stick travel. The O hose and the G-suit connections were crossed in such a manner that the stick could not be pulled back far enough to get the nosewheel off the ground. A thorough cockpit check would have precluded that hairy "near-accident."

• **Soup's on!** — Recently an overwater C-97 flight with 65 passengers aboard encountered an over-speed condition on all four turbo superchargers. Fortunately, the manifold pressure was brought under control and the aircraft landed safely.

The over-speed condition was the result of a short in the electrical circuit, caused by coffee spilled on the turbo over-ride switches. Previous to this incident, various C-97 airplanes have suffered various communications failure and mechanical malfunctions caused by coffee, fruit juices, soups, and other liquids being spilled on the control switches.

Careless food handling is not only unsanitary but downright dangerous. Watch your table manners, and if you gotta eat, please be neat!

• **Jet GCA's** — Captain Robert E. Eager, 3200th Fighter Test Squadron, APG, Eglin AFB, has come up with a new GCA procedure for jet fighters. Squadron members have tried it out many times on all USAF jet fighters, with the exception of the F-89, while running GCA flight tests.

The procedure is designed to allow a pilot to fly his GCA pattern at one throttle setting and eliminates remembering various power settings for different configurations. Weight changes are compensated for automatically.

In describing the pattern, Eager emphasized that the secret was to set up the proper power setting as a pilot enters the GCA run.

- Set the power up for maximum allowable airspeed with a gear down configuration.
- Put the speed brakes out on the downwind leg. (This is equivalent to having the gear down.)
- While turning on the base leg, drop the gear. Use combination of gear and speed brakes to lose altitude to that desired on base leg. (Retract speed brake 200 feet above desired level off altitude.)

**Major General V. E. Bertrandias, Deputy Inspector General, USAF, gets first hand information from Colonel Francis S. Gabreski, the Air Force's leading ace, prior to a familiarization flight in a T-33 jet trainer at Norton Air Force Base, California.**

- Roll into turn on final and drop wing flaps to the number of degrees needed to maintain desired final approach airspeed.
- Set up rate of descent and open speed brakes. Approach airspeed can be varied slightly to maintain a constant rate of descent.

The procedure has worked so well that it is now being taught in the instrument instruction section of the 3200th Squadron.

• **Globemaster Pioneers** — The Sixth Air Transport Squadron, currently stationed at Brookley Air Force Base, Alabama, recently was commended for chalking up an enviable flying safety record.

Flying the C-74, the prototype of the C-124, the Sixth is pointing toward a two-year accident-free safety record. The only Air Force unit utilizing the C-74, the Sixth has recorded no fatalities involving aircraft since the single-deck Globemaster was put into service in 1947.

In addition to the no-fatality accomplishment, the Sixth has flown some 72,000 hours with only four flying accidents during the entire six-year period of operation.

Capt. Marvin E. Fouche, Flying Safety Officer, reports that the crews flew nearly two-and-a-half million miles during the fiscal year 1953, carrying 20,454 passengers, and transporting 18,985,911 pounds of cargo and mail. The aircraft in the squadron have averaged 6,600 hours.

The Sixth has served mostly on long overseas flights into the Near and Middle East and was on continuous duty during the Berlin Airlift. More recently, the unit has seen extensive service in support of the Korean conflict, in addition to transporting SAC units to overseas points.

MCMXLVII

Mr. Lewis is the former Vice-President of Curtiss-Wright Corporation. From 1934 to 1947 he was responsible for directing Lockheed Aircraft Corporation's purchases, outside production, and subcontracting. From 1947 to 1950, Mr. Lewis was with Canadair, Ltd.

As Assistant Secretary in charge of Air Force Materiel matters, including production and procurement, Mr. Lewis is eminently qualified.

# "NEVER ENDING EFFORT..."

***"Flying safety must be a never ending effort by everyone in the air and on the ground.***

***"Our expanding Air Force has placed an abnormal financial burden upon the economy of the nation. Military and commercial genius have banded together to provide us with the best possible aircraft and allied equipment.***

***"Maximum utilization of this equipment can only be obtained through safety consciousness and safe practices."***

Roger Lewis

**Assistant Secretary of the Air Force**

# *Know Your True Airspeed vs. Bank!*

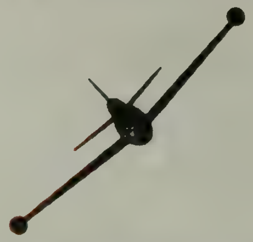
## TAS 150 MPH

**Approximately 20 degrees of bank necessary for a standard rate turn.**

## TAS 250 MPH

**31 degrees of bank required for a standard rate turn.**

## TAS 400 MPH



**At this TAS, standard rate turn requires 44 degrees of bank.**

TRUE airspeed (indicated airspeed corrected for installation error, temperature and pressure) controls the degree of bank required for a given rate of turn. The illustrations at the left show that, on instruments, standard rate turns at a true airspeed above 250 MPH are impractical because of the steepness of the bank. Also, it should be remembered that indicated airspeed is not a good indication of the bank required to maintain a standard rate turn. For example: On a standard day at 2,000 feet, with an airspeed of 220 MPH, a standard rate turn requires 27 degrees of bank. At 30,000 feet on a standard day and with the same indicated airspeed it requires 41 degrees of bank to maintain a standard rate turn.

***BE SMART, FLY SMART WITH FLYING SAFETY***

☆ U. S. GOVERNMENT PRINTING OFFICE 1953—2711

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# FLYING SAFETY

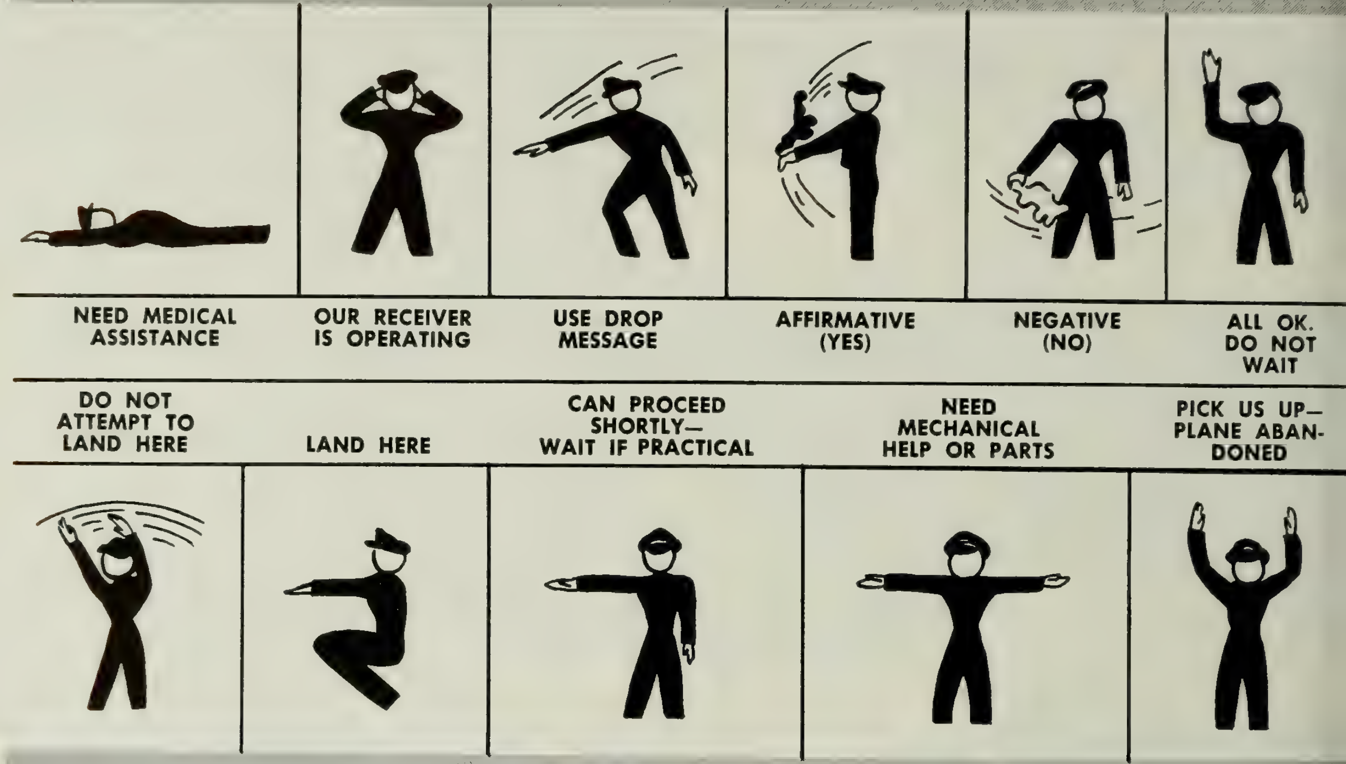
UNITED STATES AIR FORCE

OCTOBER 1953

**CAN YOU READ THIS MESSAGE?**

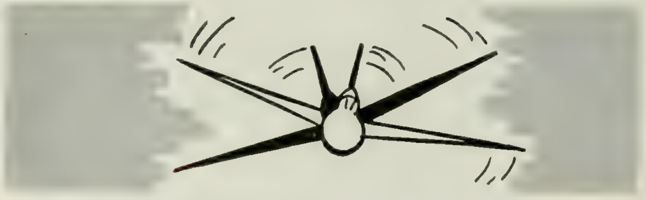
see page one . . .

## BODY SIGNALS


NEED MEDICAL ASSISTANCE
OUR RECEIVER IS OPERATING
USE DROP MESSAGE
AFFIRMATIVE (YES)
NEGATIVE (NO)
ALL OK. DO NOT WAIT
DO NOT ATTEMPT TO LAND HERE
LAND HERE
CAN PROCEED SHORTLY— WAIT IF PRACTICAL
NEED MECHANICAL HELP OR PARTS
PICK US UP— PLANE ABANDONED

## STANDARD AIRCRAFT ACKNOWLEDGEMENTS

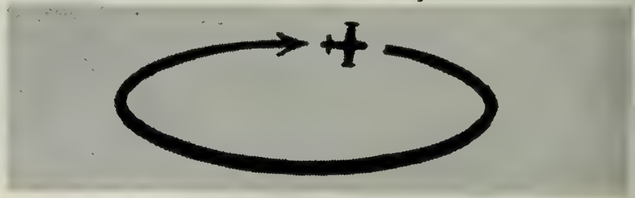
**MESSAGE RECEIVED AND UNDERSTOOD:** Aircraft will indicate that ground signals have been seen and understood by—



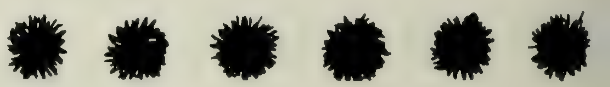
**DAY OR MOONLIGHT:** Rocking from side to side.

**NIGHT:** Making green flashes with signal lamp.

**MESSAGE RECEIVED AND NOT UNDERSTOOD:** Aircraft will indicate that ground signals have been seen but not understood by—



**DAY OR MOONLIGHT:** Making a complete right hand circle.



**NIGHT:** Making red flashes with signal lamp.

*TIME can be all important in a survival experience. If you are down without radio communications, the lives of injured personnel may depend on your ability to send and receive signals. Study and memorize body and panel signals and learn to recognize standard aircraft acknowledgments. Learn to use a signal mirror. Preparation and knowledge can save your life.*

## *MEMORIZE THE "SIGNS FOR SURVIVAL" NOW!*

Department of the Air Force
The Inspector General USAF
ajor General Victor E. Bertrandias,
Deputy Inspector General

★ ★ ★

rigadier General Richard J. O'Keefe
Director
irectorate of Flight Safety Research
Norton Air Force Base, California

★ ★ ★

Colonel John R. Dahlstrom
Supervisor of Flight Safety
Publications

★ ★ ★

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VOLUME NINE
NUMBER TEN

# FLYING SAFETY

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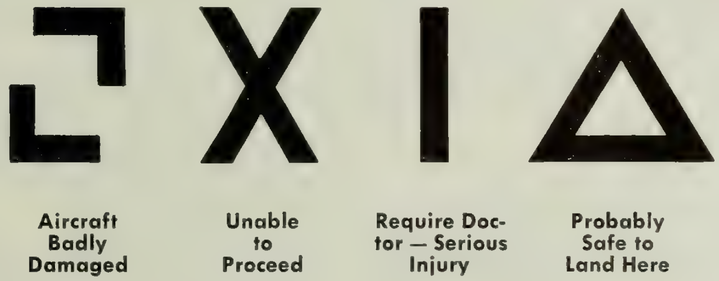
Here is the translation of the cover message spelled out in the International Ground-Air Emergency Code:



# . . . flight throug

THERE are many pilots and engineers, both military and civilian, with extensive experience in flying under actual icing conditions. From them we find that varied conclusions are drawn relative to aircraft icing, and the methods used in combating it. Aircraft icing is a very controversial subject. This article not only covers many known facts, but also includes the opinions of pilots and engineers with many hours of actual experience in icing conditions.

It is an established fact that ice forms when two conditions occur simultaneously. Moisture in liquid form must be present in the air and the effective temperature must be freezing or lower.

Since all clouds contain moisture in some form, you can expect icing if the cloud temperature is at or below freezing.

In some cases, light ice or frost forms when an aircraft flies from a cold area that has reduced the temperature of the airplane itself to freezing, into a saturated cloud area where the temperature is slightly above freezing.

Super-cooled water droplets can exist in the atmosphere in liquid state, surrounded by air of below freezing temperatures. This apparent phenomenon is caused by a combination of factors that prevent these droplets from freezing.

The surface tension of the drop, its salt content, and most important, the fact that the liquid is undisturbed, all are conducive to the droplet remaining in the liquid state. But once broken or disturbed, as when it strikes an airplane, it turns into ice. Actual flight tests have shown that water can exist in atmosphere temperatures of −35° C. to −40° C.

### Severity of Icing

The severity and type of icing is determined by the size and number of the water droplets that strike th plane and the stability of the air tha supports them.

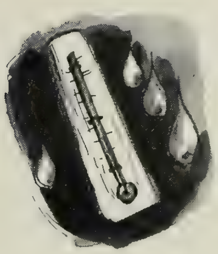
When super-cooled drops are sma in size, their surface tension is grea So great in fact, that some of ther rebound from the aircraft when the strike, while others cling and freeze When these super-cooled drops ar large, they tend to splatter when the hit and then freeze. This results in smooth, thin layer of ice.

The very fine moisture particles ar the kind that form rime ice. This i the same kind of ice that you'll fin on the coils of the old faithful kitche refrigerator. Opaque in appearanc and quite granular in form.

Rime ice in its purest form i found generally in stable weathe conditions (stratus type clouds) where vertical motion is restricted. I is not too cohesive or very strong an can be broken off readily by use o the de-icer boots.

# ICE!

Compiled from reports of an air transport survey of civil and military organizations by Colonel Rufus K. Ward, Directorate of Readiness and Material Inspection, 1002d Inspector General Group.



Rime ice tends to conform more closely to an airfoil section than does clear ice. The weight of rime per unit is less than clear ice, thus adding less weight to the gross weight of the plane. The greatest resultant danger is the added drag caused by the rough ice surface.

Clear ice is formed from large, super-cooled water droplets and is more dangerous at lower temperatures. It is tenacious, harder and smoother. It is difficult for de-icer boots to remove, once it has built up. It may at times take on a roughened appearance, but it is never granular. Remember this latter, when attempting to distinguish the nature of your super cargo. Actually, most ice is a mixture of rime and clear.

The airflow about the plane has little effect upon the pattern that clear ice will assume. It usually builds forward from the leading edge of the wing and has a decidedly adverse effect on aerodynamic performance.

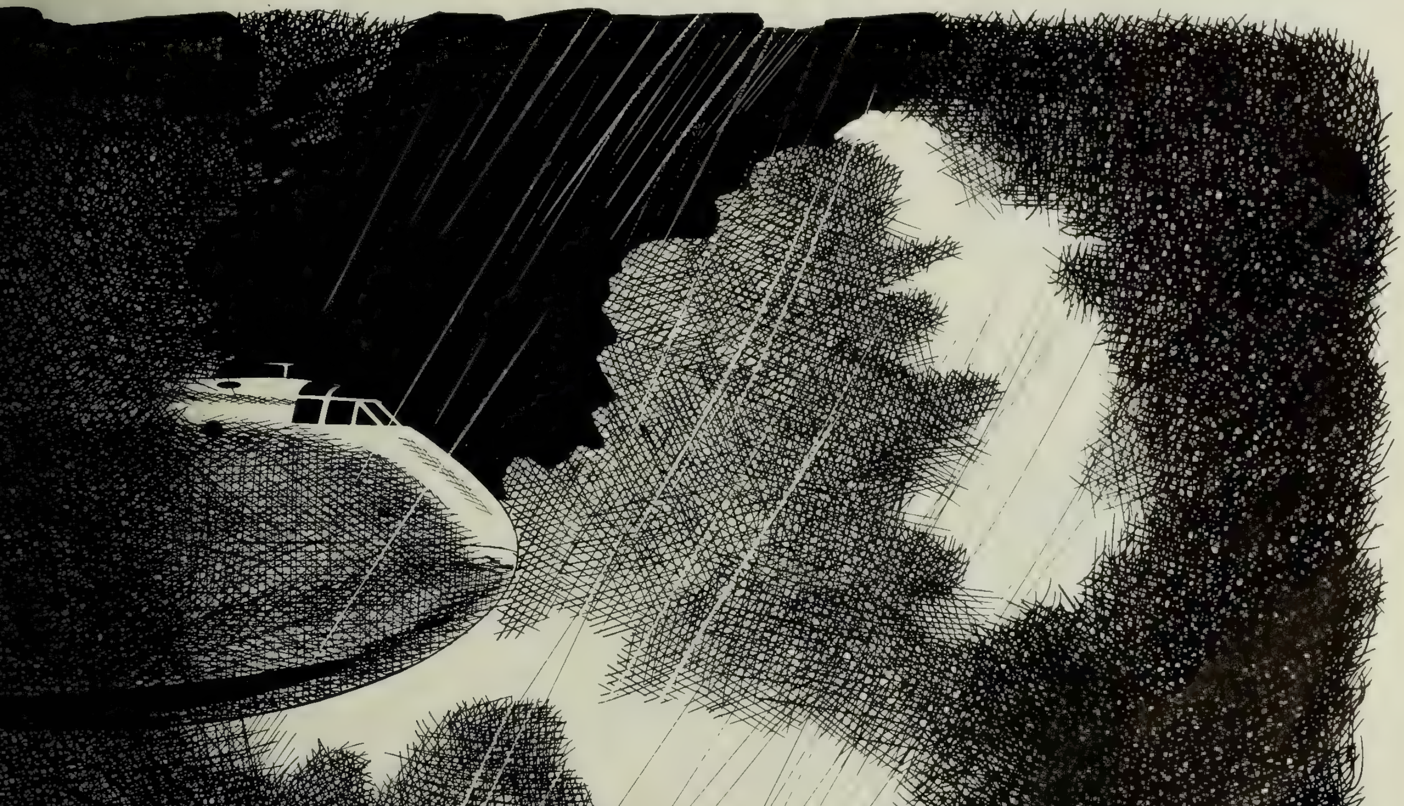
Clear ice usually starts forming by closely following the wing contour as does rime, but if allowed to go unchecked will build forward in a blunt, unstreamlined mass. It can build up remarkably fast, and has been known to force an aircraft down as little as 10 minutes after beginning to form.

In theory, zero degrees Centigrade being the freezing point of water, ice should not form above that value. However, in actual practice light ice or frost forms occasionally on aircraft in flight when outside air temperatures are slightly higher than freezing. The explanation for this centers around the fact that the metal skin of the aircraft is at or below freezing temperatures. As it flies into rain or moisture, with ambient temperatures slightly higher than freezing, the droplets strike the structure of the aircraft and splatter or spread, thus greatly increasing their area. This increases the radiation of heat from the water to the atmosphere and if this radiation plus evaporation is great enough, the temperature will drop to that of the skin of the plane and ice or frost may result.

Pilots should be a trifle leery of poking into areas where the ambient temperature is suspected of being higher than that of the plane, when the aircraft's temperature is below freezing.

Remember then, at outside air temperatures slightly higher than freezing, ice can form under ideal conditions.

It is a known fact that clear ice is more likely to form at temperatures nearer freezing than rime. The most critical range for the formation of clear ice generally extends downward from 0° C. to about −10° C. Below that, the water droplets will probably become smaller and not as apt to



form clear ice, except possibly in the tops of heavy cumulus clouds and thunderstorms.

Below about −10° C. is the region of temperature at which rime ice is most likely to form.

### Rate of Accumulation

Four factors govern ice build-up on a wing: the amount of super-cooled water present, the temperature of the air, the area and roughness of the surface exposed and lastly, the airspeed of the aircraft.

The first of these factors can be estimated in flight by the darkness of clouds encountered and their vertical development. Sharpness of the contour of clouds indicate active buildup and consequently larger amounts of water vapor in the air. In stratus clouds, the lower levels contain the most moisture.

It must be borne in mind that under normal conditions, the lower the air temperature, the less relative amount of water will be present. However, it must also be remembered that as long as moisture is present there is some danger of icing.

It is known that any rough surface over which air flows not only cuts down the aerodynamic cleanliness of the plane, but also becomes an anchoring point for ice. Rough paint, rivet heads and frost particles are especially bad in this respect. Frost is unquestionably the worst of the offenders as ice will start building upon a frost base in short order.

Considerable controversy has been evidenced relative to speed versus amount of ice accumulation. There appears to be one simple solution to this problem. Remember this established fact: the *rate* of accumulation is always higher at higher airspeed, but, the *amount* of accumulation may be greater at slower speeds.

Although this will not come as a sudden shock to any pilot, we'd like to reiterate one of your earliest lessons on winter flying. The main effect of wing ice is to disturb the normal airflow about the wing. This results in loss of lift, in varying degrees, and increases the drag. Basically, it is the shape rather than the weight of ice that is the troublemaker. Admittedly, a half-inch of clear ice on a C-54 will increase the gross weight by approximately 6,500 pounds, but this will result in only about 20 gallons an hour increase in gasoline consumption, to maintain the same airspeed. However, what that extra 6,500 pounds of surplus weight will do to the stalling speed is something else again!

If you ever find yourself lugging that kind of a load, just bear in mind that you'll have to keep the old airspeed really on the high side while grinding around the traffic pattern. Keep the final hot, but don't run yourself fresh out of runway in the process of landing. There's a happy medium in this sort of predicament and only experience can give you the answer.

Pilots have been known to get into some rather peculiar attitudes and altitudes while attempting to run the gauntlet of severe icing. They have found that in trying to maintain a constant altitude, wing ice can cause the use of an increasing amount of power and angles of attack. Increased angles of attack subjects more area of the plane to icing, while increased power burns up more and more gasoline. The change in attitude allows ice to build up on parts of the airframe where de-icer equipment is not available. It's a vicious circle and the only answer is to change altitude.

### Hazard of Wing Ice

The first indication of wing ice is a thin, white ribbon that develops along the leading edge of the wing. This strip gradually builds forward, upward and downward from its starting point around the center of the wing. Its initial effect upon performance is negligible, but as it builds and disrupts the airflow more and more, the hazard increases.

Although it is usually impossible to see the empennage from the cockpit, it may be safely assumed that if ice is observed forming on the leading edge of the wing, a simultaneous action is taking place on the tail surfaces. As ice forms on the vertical an horizontal stabilizers, an increase tendency to yaw will be noted.

Propeller ice will cause loss of efficiency in varying degrees. This condition will probably demand an increase in fuel consumption and wil materially affect airspeed. If ic forms on one or two blades of a pro and not on others at the same time, vibration moment will be establishe that can soon reach disastrous proportions.

Although ice will normally form o all prop blades at the same time, quit often it will break free or be throw from one blade. Then the shaking ac starts in earnest. Prop ice is likel at any time wing ice is picked up.

A propeller will rarely ice its entire length. Slower RPM is more conducive to a prop icing, but at norma cruising RPM, one-half to two-third of the length of the blade is as far a icing will extend. Even this amount o coverage can cause serious consequences and the wise pilot will employ preventive measures prior to entering known icing zones.

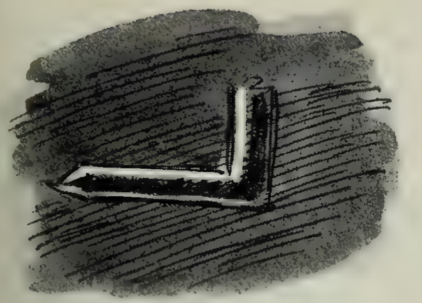
Turn on the propeller de-icers before entering icing areas, and coat the blades thoroughly with fluid. Then, retard the flow to about two quarts per hour, per propeller. This amount will be sufficient for normal icing. The problem here is not to exhaust the supply of fluid needlessly. but rather to use just enough to kee the blades free.

At night it is often difficult to determine if propeller ice is forming except by falling back on the old flashlight. Throw the beam on the whirling disk near the hub. Spinning, circular streaks will indicate that ice is forming. It is a fairly sure bet that if ice is forming on the spinner, it will be building up on the blades too.

Icing on props is indicated sometimes by engine vibration and loss of airspeed due to decreased propeller efficiency. If prop ice has caught you unawares, and de-icer fluid seems to have no effect, increase and decrease RPM several times, then use fluid to keep the blades clean.

### Other Icing Problems

Pitot tube icing is extremely dangerous since it causes inaccurate readings of the pitot system flight instruments. It is the easiest to combat, however. The heating element in the pitot tube is sufficient to melt



ice under the most adverse conditions and should be used whenever icing conditions are anticipated.

Radio antennae icing can be serious and is relatively hard to prevent. Antennae icing can cause the mast to vibrate and the wires to sag and eventually break under the increased weight.

Ice bridging over the insulators and grounding the antennae to the plane's structure will cut off all communication. The only remedy is to change altitude and find a warmer stratum of air where the ice will melt. Sometimes it is possible to melt ice from the antennae by holding the transmitting key down and setting up sufficient induced current to do the job. It is not considered too practicable to depend upon this method of ice removal, however.

Windshield ice can be tolerated up to the point where a landing is contemplated, but from that point on, some means must be provided for forward vision. Many windshield deicing systems are currently employed, and all are workable to a certain degree. However, almost all manufacturers provide a sliding or hinged front or side window that may be employed in the event the windshield is iced up to a point where all mechanical aids fail to clear it properly.

Carburetor ice is as important as wing or prop ice in its adverse effect on the aircraft, and many pilots rate it first in importance.

Carburetor ice may be divided generally into three types: impact ice, throttle ice and fuel evaporation ice.

Carburetor ice does not depend upon the factors of visible moisture and freezing temperatures that characterize all other kinds of icing. It can form when there is not a cloud in the sky and at temperatures well above freezing, if the humidity is high enough. Because of the refrigerating effect of expanding air and vaporizing gases, temperatures in the adapter can be as high as 15° C. but still lower than the outside air temperature, and if humidity is great enough, ice will form in the carburetor.

Impact ice is formed when any kind of moisture in the air, whether from rain, snow or humidity, freezes upon contact with surfaces that are below freezing temperatures, in the same way that structural ice forms on the aircraft. The most dangerous phase occurs when it forms on the metering elements of the carburetor, affecting fuel-air ratio by either leaning or enriching it. Other vital areas are the walls and elbows of the airscoop, the screens, pre-heater valves and adapters.

Throttle ice is formed on or near the throttle when it is an intermediate position between full open and full closed. Near freezing particles of moist air in the air stream strike the metal surfaces around the throttle and freeze there. Generally temperatures most conducive to the formation of this type of ice are between $-1°$ to $+5°$ C. Ice can form at temperatures higher than this, but the metal is too warm for it to adhere to and no throttle ice results.

Fuel evaporation ice is similar to carburetor icing. To what extent this phenomena may occur depends largely upon the type of carburetor used, the quality of the fuel, the altitude flown and location of the fuel jets. All of these variables make the prediction of fuel icing rather difficult, but any moisture brought into the air scoop containing a high relative humidity can result in icing.

### Affects Fuel Flow

Any of the above conditions, but especially fuel icing, can alter the existing fuel-air ratio, usually by enriching it, but occasionally leaning it, depending upon where the ice forms in the carburetor.

Ice can affect fuel flow by closing the adapter passage, causing some cylinders to run lean or rich by upsetting the fuel flow at the nozzle distributor. But regardless of what the specific cause is, the net result is loss of power and loss of airspeed, if level flight is maintained.

Indications of carburetor icing are loss of manifold pressure on constant speed props and loss of RPM on fixed pitch installations. This is the only sure indication and whenever icing is suspected, preventive action should be taken at once.

If manifold pressure changes, apply full heat for about one to two minutes, and after returning to the full cold position, see if your manifold pressure returns to the same value as before. If it returns to a higher reading, you had ice.

Any time that you are flying through regions of high moisture content, it is advisable to be on the lookout for the possibility of carburetor icing.

If ice has formed in the induction system and heat is not sufficient to melt it off, the induction system deicing alcohol or aniloil systems will usually do the trick. If heat is used properly, the icing has to be rather severe before it is necessary to use alcohol. Alcohol should be used only to remove ice, as small quantities of alcohol aggravate icing due to the temperature drop caused by the vaporization of the alcohol.

One final warning concerning carburetor heat: The amount of moisture in the air affects the ability of the carburetor heat control to effect a given rise in temperature. The higher the moisture content, the harder it is to raise the temperature. This is important to know when flying through heavy rain.

Also, if icing is encountered, move the carburetor heat control a few times to prevent the door from freezing in any one position.

The one basic rule to follow under *any* icing condition is — AVOID FLIGHT INTO KNOWN ICING AREAS WHENEVER POSSIBLE.

The easiest way to combat ice is to never get it in the first place. Naturally, this is not always possible, especially in military flying, but it should always be the first thought in combating icing conditions. Even in over-ocean flying, where a course can be altered considerably, it may be impractical to try to circumnavigate an icing zone because of the fuel in-

volved and the possibility of not being able to get a sight. So, if unable to avoid ice, the next best thing is to arm yourself with knowledge on how to combat ice.

If you have to ascend or descend through an icing layer, do so as quickly as possible. The longer you are exposed to icing, the more you are likely to pick it up. If practicable, a fast rate of descent at a relatively slow airspeed is best for descents, and in climbs up through icing, maximum climb or rated power at the best rate-of-climb airspeed is preferable.

When flying through sleet, the below freezing temperatures and high water density content are in the clouds above, from which the sleet is falling, so stay where you are.

When flying through freezing rain, the most dangerous icing condition known, the above freezing temperatures must be present in the clouds from which the rain is falling, so climb immediately to the warmer air.

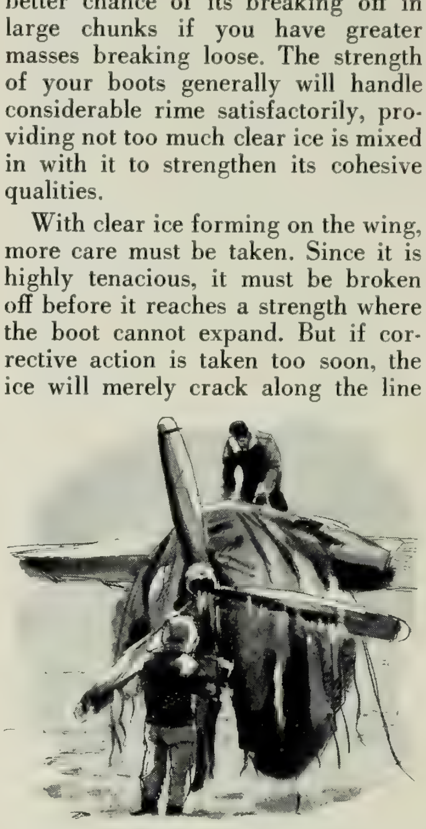
When flying in cumulus clouds or mountain turbulence and encountering clear ice, climb to an altitude where the temperature is around −10° C. or lower, and ice probably will not form faster than de-icer equipment can handle it. If this same situation exists over water, and above freezing temperature exists at the surface, a better plan would be to descend. Terrain and surface temperature dictate whether to climb or to descend, in this situation.

When flying into wet snow, ice might be picked up, but colder temperatures exist above and the snow aloft presents no icing problem, so climb until hard snow is encountered. Remember, never take off in wet snow, as it may freeze before you can gain altitude.

To use de-icer boots properly, you must first understand their limitations and capabilities. Ice that does not cover two or more of the parallel tubes in the boot should be left alone. It will not be sufficient to cause serious consequences, and if the boots are turned on, only a part of the ice is likely to be broken loose. The chunks that remain not only destroy the airfoil more than the original formation, but act as a rough base for additional ice to adhere to and build up unevenly.

Since rime ice usually forms on the wing leading edge, the aerodynamic efficiency of the wing is not greatly impaired. And since it is granular in make-up, you stand a better chance of its breaking off in large chunks if you have greater masses breaking loose. The strength of your boots generally will handle considerable rime satisfactorily, providing not too much clear ice is mixed in with it to strengthen its cohesive qualities.

With clear ice forming on the wing, more care must be taken. Since it is highly tenacious, it must be broken off before it reaches a strength where the boot cannot expand. But if corrective action is taken too soon, the ice will merely crack along the line between the inflated and deflated sections of the de-icer boot and will not be eliminated.



Experience has shown that about one-eighth of an inch to one-quarter of an inch is the correct thickness to begin boot operation. In clear ice it is better to begin de-icing too soon than too late. Once ice has formed thick enough to make your boot inoperative, you are at its mercy.

If either clear or rime ice are encountered for a short time only and it is certain that the aircraft will break out into clear air soon, the best procedure is to let it alone. Use your boots after you are through the icing zone to break off the majority of the ice and let evaporation clean up the rest of the wing for you.

Remove snow, frost, sleet and any other foreign particles that have frozen to the aircraft before any takeoff is attempted. Nothing short of an aerodynamically clean plane should be flown on a takeoff. Wing covers are available at any cold weather base, and ten minutes taken to put them on may mean hours saved trying to de-ice a plane.

If throttle ice is suspected, check movement of throttles before landing. You may want to go around and not have the power available for a pull-up.

Fly manually through icing, and move the control surfaces from time to time if the air is smooth to prevent them from freezing at the hinges and impairing their movement.

No matter what kind of ice is encountered or where on the plane it occurs, *gas consumption goes up.*

When warming up for takeoff, move the carburetor air controls to full hot on all engines to eliminate whatever ice has formed, and then return them to full cold for takeoff. Do not warm up where slush and moisture can be picked up by the props and thrown back over the wings and tail surfaces.

In landing with ice, make wide shallow turns, turn the wing-de-icers off, and *maintain plenty of airspeed.*

Beware of slippery runways with their resultant poor braking action. In short field landings with ice, only experience and keen judgment can dictate the slowest safe airspeed at which to cross the fence.

Today, many of our modern aircraft are equipped with thermal anti-icing systems, utilizing hot air and electricity. The trend is to provide hot air for anti-icing of flight surfaces, and electricity for anti-icing of propellers, radio masts and pitot assemblies.

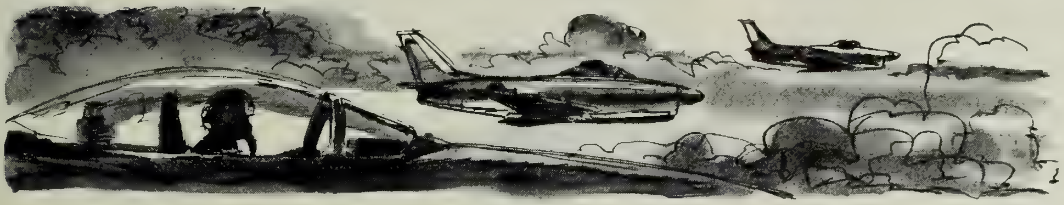
Using the system may be accomplished in two ways: The heat may be applied after the icing starts because regardless of the amount and type of icing, heat will melt off the ice. The recommended method is to turn on the heat before entering an area of icing. The second method will lessen the amount of run-back of melted ice. It also eliminates the possibility of chunks of ice breaking loose, blowing back, and damaging the airplane.

In electric prop anti-icing, if you suddenly enter icing with very little warning, it is wise to use maximum heat for several minutes until the blades are well heated before returning to a lesser heat intensity.

One word of warning on electric prop anti-icing. *Never use prop heat on the ground.* Temperatures can become so high as to take the temper out of the blade. ●

# Jet Engine Icing

## Ice on fixed inlet screens and compressor guide vanes results in loss of thrust and temperature rise in jet aircraft.



BECAUSE OF BASIC DESIGN vagaries and certain facets of configuration, axial flow jet engines are more positively affected by icing than are centrifugal compressor power plants. Not that engine icing isn't an extremely important subject to *all* pilots!

The overall aspects of icing are covered elsewhere in this issue (see icing story, page 2). But because of the accelerated jet program, it is believed that engine icing of jet aircraft is of particular importance, and the instructions contained in T. O. No. 01-1-469 (29 June 1953), are spelled out here for the guidance of all pilots who fly jet aircraft.

It is generally conceded that heaviest icing usually takes place in clouds with strong vertical currents. Icing conditions in stratus clouds are usually light to moderate, but you *can* run into heavy ice in stratus, especially if your flight is of extended duration. Weathermen agree that the heaviest ice formation will generally be found at about −5° C.

### Axial Flow Engines

In axial flow jet engines, ice forms on fixed inlet screens and on compressor inlet guide vanes. This tends to restrict the flow of inlet air, and the result is a loss of thrust plus a rapid rise in exhaust gas temperature (tailpipe temperature). As the air flow decreases, the fuel-air ratio increases, and the temperature of the gases going to the turbine is raised.

Attempts to raise engine RPM by fuel control increase only aggravates the condition, and should be avoided at all costs.

Ice build-up on inlet screens, heavy enough to cause turbine failure, can occur in less than 60 seconds when icing is severe. Even with the inlet screens removed, the air passage between the inlet guide vanes can be blocked in four minutes or less under extremely severe icing conditions. Current engines in this category include most models of the J-35, J-47, J-57 and J-65.

### Wrong Idea

One idea that jet pilots should get out of their heads right now is that forcing heat by the use of ram pressure at high speeds will prevent icing. Nothing could be further from the truth. Not enough heat is generated at sub-sonic velocities to prevent the formation of ice. The rate of engine icing for any given atmospheric icing intensity, with outside air temperature below freezing, is relatively constant up to a true airspeed of 250 knots. Above 250 knots TAS, the rate of icing increases in ratio with the true airspeed. It is quite obvious, therefore, that reducing the airspeed to a safe minimum will reduce the rate of inlet icing.

Inlet duct icing can occur without the formation of ice on the fuselage and wing surfaces. When axial type jets fly at airspeeds below 250 knots TAS, with high power settings as in a climb, intake air is *sucked* into the engine compressor inlet, rather than *rammed*. This suction causes an air temperature decrease; and air at ambient above-freezing temperatures can easily be reduced to below-freezing as it enters the engine. The free moisture in the air is super-cooled, and causes engine icing, even though there is no external evidence of icing conditions.

The maximum safe temperature drop that can occur on most axial-flow engines is 5° C. The greatest temperature drop is found when the airplane is being run on the ground at high RPM.

### Centrifugal Types

Centrifugal compressor type jet engines are relatively free from icing difficulties. Engines in this category are the J-33 and J-48. While it has been possible to ice the J-33, icing conditions must be extremely severe.

The J-33 engine has also been known to ice up on the ground in some airplanes.

Pilots should learn to recognize jet engine icing by any increase in tailpipe temperature. This is usually the only indication before the mill quits cold. If you do get a tailpipe rise, and weather conditions are ripe for icing, learn the recommended procedures outlined in the Dash-One.

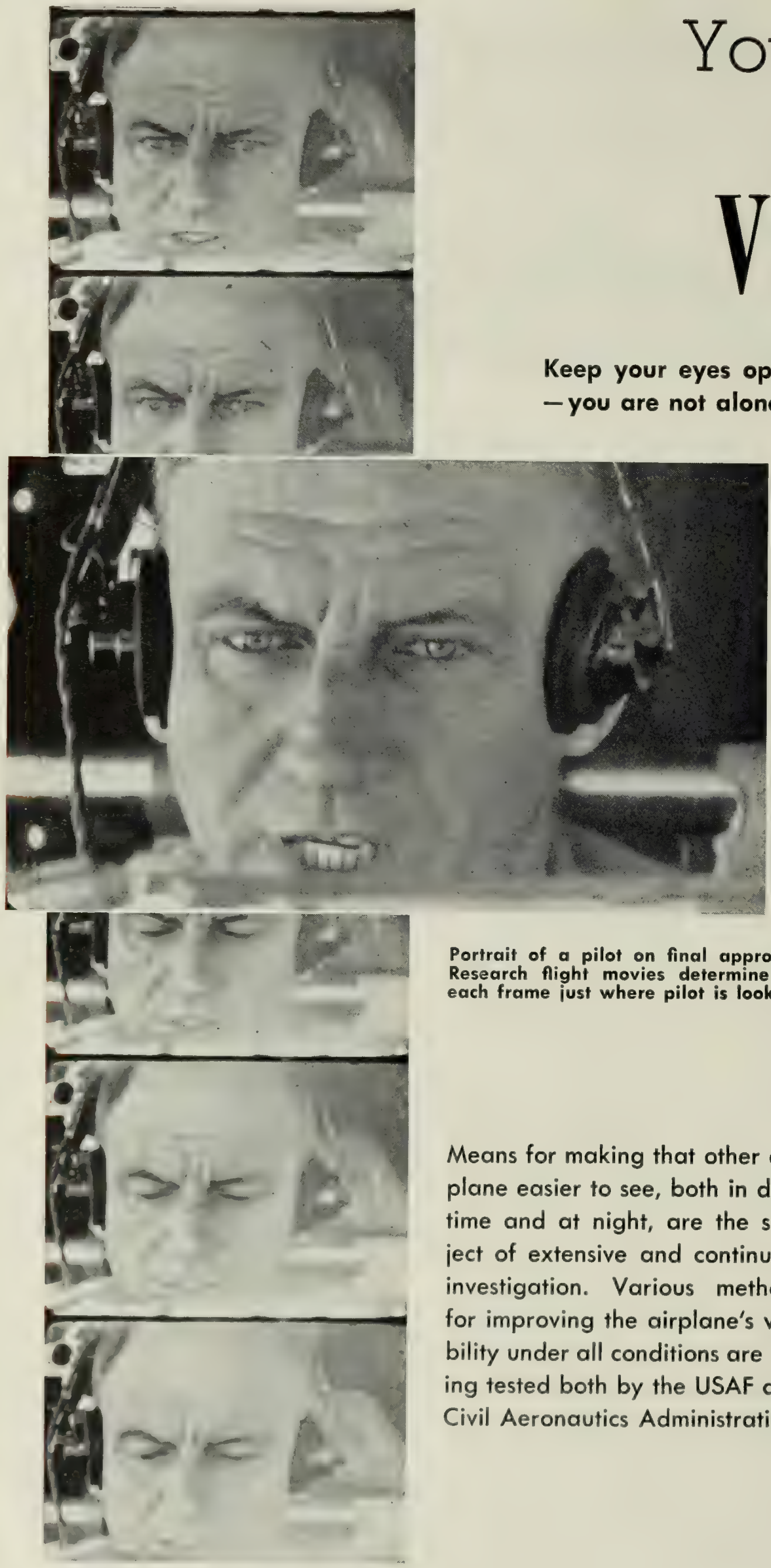
In the first place, learn to avoid atmospheric icing conditions whenever possible. This is predicated on careful flight planning, and close coordination with the weather people.

If the ambient temperature is in the approximate range of 0° C. to 5° C. and the atmosphere is moist, the speed of the airplane should be held to 250 knots TAS. If actual icing is encountered to a point where it is visible on the outside of the airplane, the airspeed should be reduced, the altitude should be changed immediately by climbing or descending, the heading should be changed to avoid all possible cloud formations and a close check made on the tailpipe temperature. Engine RPM should be reduced to a point where tailpipe temperature can be kept at a safe maximum.

Jet engines protected by anti-icing systems and retractable inlet screens are not susceptible to icing hazards. However, on such engines, screens should be retracted prior to takeoff when potential icing conditions exist. ●

# Your Point of VIEW

### Keep your eyes open and your head on a swivel —you are not alone when you're cruising in the blue



**Portrait of a pilot on final approach. Research flight movies determine for each frame just where pilot is looking.**

Means for making that other airplane easier to see, both in daytime and at night, are the subject of extensive and continuing investigation. Various methods for improving the airplane's visibility under all conditions are being tested both by the USAF and Civil Aeronautics Administration.

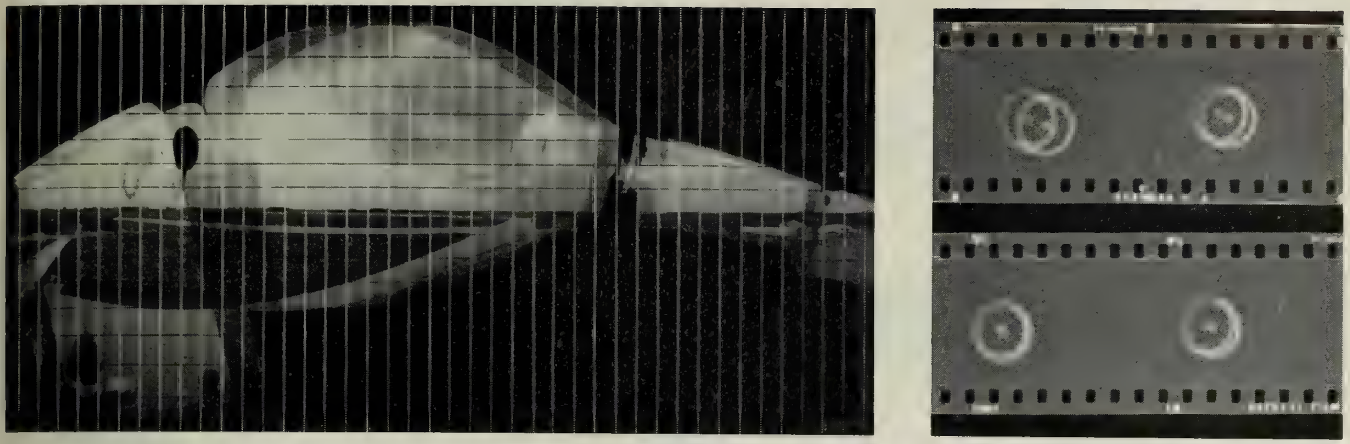
YOURS is not always the only airplane in the wild blue yonder. Sometimes there is another one, and sometimes it is heading your way. It is always nice to see it in time to avoid a collision. The question of "how you look at it" is important. The windshield and windows must be big enough. How far up and down should the pilot be able to look? How far to the left and to the right? What about distortion? Can we make that other airplane more conspicuous, easy to see?

The answers to those questions are emerging from a program of study and testing now in progress at the Civil Aeronautics Administration Technical Development and Evaluation Center at Indianapolis, Indiana.

This is not a quickie; there are a number of "swinging doors." For example, the cockpit can not be all glass. What about instruments, controls and other essentials in the cockpit? There is the matter of sun glare. How much vision can the pilot use? Will high intensity lights be effective in daylight? How about the electrical power required to operate them? We must be practical.

The answer to the cockpit vision problem is being furnished through several fixes. An analysis of pilots' opinions has obtained one fix. Measurements of where they look while flying have obtained a second. Recently completed flight path measurements and studies have determined relative angles of vision between two airplanes for any combination of flight paths that would lead to a collision. A flight program soon to be started will determine what angles of vision the human machine is able to use.

Pilots' opinions were obtained



Panorama, above, measures extent of pilot's vision from C-47 cockpit in terms of angles. The groups of circles measure waviness of windshield, as indicated by their displacement.

through the use of a carefully prepared questionnaire so worded that a numerical evaluation of their thinking was obtained. Some 1500 of these, involving eight transport aircraft models, were analyzed. This required accurate measurements of the vision angles provided by the particular aircraft models involved.

To obtain such measurements a camera-mounting arrangement was developed. This, in effect, is a swivel-necked robot that sits in the pilot's seat and photographs the windshield and windows from the pilot's eye position as it rotates through 360°. It has two lenses that look around posts as do the pilot's eyes.

### Double Exposure

The resulting picture is a deliberate double exposure, but it is a true measurement of the effective angles of vision and post widths as would be seen by the pilot using both eyes (binocular vision). The vision angles at all points along the edges of the windows and windshield can be determined immediately, since the angle grid lines are a part of the picture.

These eye motion records during flight were obtained in the Boeing Strato-cruiser through the courtesy of Pan American and United Airlines. This airplane model was chosen because it provides greater angles of vision than any other transport.

Before each flight, photographs were taken of the pilot's eyes as he looked steadily at various fixed points around the windshield. When these reference photographs were compared with the motion pictures taken during flight, it was possible to determine, frame by frame and within 10 degrees, where the pilot was looking.

Some 30,000 frames were individually analyzed by two independent readers. The photos involved 14 pilots while taxiing, taking off, climbing, approaching and landing.

The analysis of those measurements also determined optimum window and windshield contours. These corresponded closely with the contours as determined by the pilot questionnaire study.

Investigations of devices that provide vision beyond that provided by the windshield and windows include rear view mirrors, very large wide angle (180°) lenses, and other devices. The rear view mirror has proved successful, particularly on small personal type airplanes. The wide angle lenses have certain drawbacks such as reduction in image size and a distortion of the apparent speed of an approaching aircraft. However, this study is continuing.

Windshield or window distortions appear wherever the opposite surfaces of the glass are out of parallel (wedginess). This causes a bending or deviation in the line of sight. Variations in wedginess produce a wavy effect.

The distortion measuring instrument projects a very small circle of light onto the windshield and photographs its reflections that are returned from the front and rear surfaces. If the two reflections coincide as one circle, that portion of the windshield is true. If they are displaced, the amount of displacement measures the amount of deviation in the line of sight. The instrument will detect a deviation of 0.012 degrees. This would cause an object a mile away to appear to be displaced only one foot.

Very clear daylight conditions are considered the most hazardous as concern presently equipped aircraft. The visible contrast between the airplane and the bright sky background is very poor. The traffic density is higher and, last but not least, the pilot tends to relax, to become less alert. This urgent situation is receiving high priority attention.

The night time hazard is also urgent. The conventional low intensity flashing lights are becoming less and less adequate as speeds and traffic densities increase. It appears that these should be supplemented by high intensity anti-collision lights. Various types of H. I. units are coming into use. The Center is not developing lighting units as such, but rather is devoting its efforts to the obtaining of basic numerical data that will aid in the establishment of requirements for external aircraft lighting. These involve the measurement of pilot reactions to various colors, intensities, flashing frequencies and configurations. These are now being measured in the laboratory under simulated flight conditions. Similar measurements are to be made in flight.

The avoidance of air collisions depends upon many factors. The most important is the ability to see that other airplane early. Regardless of other variables, if you can't see the other aircraft steaming up on collision course, it's going to be difficult to duck!

This study of better vision continues to be a weighty problem and isn't licked yet. But in the meantime the only logical solution must rest with you. Keep your eyes open and your neck on a swivel. ●

# how to check an Engine!

*Back in August of 1951 we devoted five pages to engine chec procedures. Since that time we have had numerous requests for re-run of the article. If we may utilize comments from the field as yardstick, it is most apparent that both pilots and maintenanc personnel have benefited greatly from the original article.*

BASICALLY, the following SOP was developed for C-47's and all figures quoted apply to that aircraft. With minor revisions, however, the procedures given can be made applicable to practically any reciprocating engine.

(Before starting, note the manifold pressure reading with the engines at rest. This setting will be used in accomplishing certain checks later.)

Start the engines as specified in T. O.'s 01-40ND-1 and 01-40NC-1. With adequate electrical power it is preferred to turn the engine with the starter for two complete revolutions before turning on the ignition switch and priming. This procedure will provide an extra safety factor against hydraulic lock in cold weather as all intake valves will have been actuated before the engine fires. This assures protection from any liquid which may have been trapped in the intake pipes from where it could be drawn into the cylinders. After the engine starts, move mixture control from the IDLE CUT OFF to the AUTO RICH position and continue priming if required.

In cold weather, the carburetor heat control may be moved to FULL HOT position as soon as the engine starts firing. This will aid in vaporization of fuel and prevent over-loading cylinders with liquid fuel. Use carburetor heat as required during all ground operation to stay within the 15° to 40° C. range. Operation above 40° C. may result in detonation.

### Preflight Checks

Throttles should be set to provide 1,700 RPM for exercising props and other preflighting where applicable. Props should be exercised four or more times to insure complete warming of prop oil and scavenging of diluted oil out of the governor system, so there will be no possibility of the governor losing control during takeoff.

If the takeoff is delayed for an extended period of time, the props should be exercised again. If the feathering button will not reduce the RPM on the first attempt, pull the button out and depress it again. Do not allow the button to remain in over 90 seconds, as damage can result to the feathering motor.

A power check should be made using the same MP as that which the manifold pressure gage showed when the engine was at rest before starting (this is field barometric or pre-start MP). The propeller governor control should be in the HIGH RPM position and the carburetor pre-heat control in FULL COLD. Unless there is some engine malfunction this will give the same RPM, ±50 RPM, on a given engine and propeller combination regardless of the outside air temperature, field elevation or field barometric reading.

Tap the instrument lightly during the power check to eliminate instrument sticking errors. Normally, the RPM obtained in the C-47 will be approximately 2,450, but this may vary with some airplanes because of a variation in the type of propelle used or the propeller low pitch sto setting. A headwind will cause higher RPM than normal. While mak ing the power check, note the engin instrument readings to make certai they are within the limits shown o the instrument face.

Make the ignition check at the fiel barometric MP just after the powe check, with the prop governor still i the HIGH RPM position. Use AUT RICH mixture position. Allowabl engine drop is 65 RPM. Tap th tachometer lightly during the ignitio check to eliminate instrument stickin errors. Allow four or more seconds a each single mag position. Recor both the fast (or initial) and the tota mag drops. Watch the engine fo roughness in addition to recordin the RPM drop.

It is permissible, but not a require ment, to make a 2,700 RPM run-u to 45" MP in order to check propelle governing and smooth engine opera tion at this high power condition. I is important to understand, howeve that this does not constitute a powe check because the propeller is no riding on the mechanical low pitc stop. This check merely indicates tha the governor is functioning properl and the engine is operating smoothly as determined by watching for engin roughness from the cockpit window

This high power condition should

be held only a few seconds as it has a detrimental effect on engine life. It is pointed out that this type of check is not made by the commercial airlines because the power check outlined above is considered sufficient for their operation. Propeller governing at takeoff RPM can be checked adequately during the first part of the takeoff run. In general, high power ground operation at 2,700 RPM should be discouraged.

For military operation under certain circumstances such as icy runways, night takeoffs in unfavorable weather conditions, the first flight that an airplane has made in several days or after considerable maintenance has been performed on the airplane, a high RPM runup can be justified. It is not necessary, however, to make such a runup before each leg of a multi-leg trip during the same day. For such a trip, numerous high power runups are apt to make the flights less safe rather than safer because of the accumulation of high power operating time on the engine.

A postflight check before the engines are stopped after the last flight of the day is outlined in T. O. 02-A-1-29.

A runup on the taxi strip is not a bad idea as taxiing at low RPM back to the apron will cause oil and cylinder head temperatures to drop low enough to accomplish suitable oil dilution if required.

Make a power check by running the engines up to field barometric MP with the propeller set in the high RPM position. This should give the same RPM as in the preflight power check, plus or minus 50 RPM, unless there is some engine malfunction. You can obtain the MP gage reading for field barometric manifold pressure even though the engines are running, by momentarily opening the MP gage drain valve and observing the gage reading while the valve is open.

Check the mags at field barometric MP. Use the same procedure as for the preflight check.

Set the RPM at 1700 and move mixture control from AUTO-RICH to AUTO-LEAN and record RPM and MP change. An increase of over 25 RPM or a decrease of more than 75 RPM as a result of the mixture change indicates an excessively rich or lean carburetor.

Pull throttles back to the idle stop and record idle RPM. After the engine speed has stabilized, move the mixture control slowly toward IDLE CUT-OFF and note change in RPM and MP. An increase of more than 10 RPM or a decrease of more than ¼″ MP indicates an excessively rich mixture.

When the RPM drops to 300, return the mixture control to AUTO RICH position.

With the mixture in AUTO-RICH, check acceleration and deceleration of engines.

At 600-700 RPM, make an ignition switch check by momentarily turning the switch to the OFF position and then back to BOTH.

In cold weather operations, proper oil dilution is the main factor in being able to start aircraft engines for the next mission. The table on the cockpit check sheet should be used to accomplish this dilution. Oil dilution should not be accomplished with an oil temperature above 50° C. To obtain satisfactory dilution, if the oil temperature is above 50° C., shut down the engine and allow oil to cool to below 40° C., then restart and dilute.

### Hydraulic Lock

Hydraulic lock is caused by the piston contacting a combustion chamber full of liquid fuel or oil. It is not likely to cause damage, provided the engine is being turned by the starter only and has not fired at the time the lock occurs. However, if the engine fires and experiences sudden stoppage, due to the piston striking the liquid, damage is quite likely to occur.

Rotation of the engine for six blades or two propeller revolutions before priming and turning the ignition switch ON gives reasonable assurance that all the combustion chambers are clear. In the event hydraulic lock is experienced while cranking the engine with the starter before the engine has fired, the lower spark plugs should be removed and the fuel or oil allowed to drain out.

Pulling the engine through backward will not satisfactorily eliminate the lock as the liquid will be pushed into the intake pipes.

Hydraulic lock resulting in sudden stoppage after one or more cylinders have fired is just cause for engine removal.

### Power Check

A pilot will sometimes make a "power check" consisting of a part throttle runup to near takeoff manifold pressure. By doing this he secures an intuitive assurance of power output without running the engine long enough at a stabilized setting to achieve an interpretable relationship between RPM and MP.

If he does run the engines to a stabilized setting, he usually does so in an attempt to check one engine against another. This constitutes a poor basis for judgment in that both engines may be in equally poor condition. Running the engine to a part throttle, high power, setting only assures that the engine may be expected to attain the same relationship again —but does not necessarily measure its mechanical condition or horsepower output reliability.

Any standard engine propeller installation in good condition, started, warmed up, and run in full low pitch up to a manifold pressure equivalent to atmospheric (pre-start MP) for the operating field elevation will attain a given RPM or "norm" from day to day and time to time. This is true, providing the carburetor pre-heat control is in the FULL COLD position. Any resulting RPM lower than the norm is a proportional measure of horsepower loss. This constitutes an accurate power check.

It is anticipated the average pilot will detect an apparent fallacy in this recommended power-check system by pointing to the fact that as inducted air temperatures vary with summer and winter, horsepower output will vary at atmospheric manifold pressure. This will upset the validity of the proposed procedure since barometric pressure varies from day to day and because of possible inaccuracies in manifold pressure instruments. Fortunately, all these factors are self-compensating. That is, the lower free air temperatures of cold days which boost horsepower also boost drag properties of the propeller turning in denser air.

The same self-correction is evident in barometric changes from day to day which equally affect air density inducted by the engine (at atmospheric MP) and propeller drag. Variations in field elevations at which the check is performed will be equally self-compensating.

The effect of wind cannot be accurately accounted for in any type of ground power check without using special equipment. A power check made with the airplane headed into the wind will result in a higher RPM than normal. An engine should never be run up with a tailwind because of the detrimental effect on engine cooling. A headwind or crosswind should never result in a low RPM reading during a power check and therefore the wind effect should not be confused with any malfunction which would result in an RPM loss.

The curve on Fig. 1 shows the variation of RPM with horsepower (or MP) while the engine is being operated with the propeller governor control in the FULL INCREASE RPM or TAKEOFF position.

From a relative low power represented by point "A" to the point where the propeller starts to govern at 2,700 RPM as indicated by point "B", the RPM increases with an increase in manifold pressure or horsepower (HP). This portion of the curve between "A" and "B" is known as a "Propeller Load Curve" because the propeller is in a fixed pitch against the mechanical low pitch stop causing the RPM to vary as an exact function of power. After point "B" is reached, a further increase in MP (or HP) no longer results in an increase in RPM because the propeller governor increases the propeller pitch to hold a constant 2,700 RPM.

Therefore, any determination of power as a function of RPM cannot be made in the 2,700 RPM portion of the curve from "B" to "C". It must be made in the "propeller load" portion of the curve from "A" to "B".

FIG. 1
POWER VARIATION WITH RPM

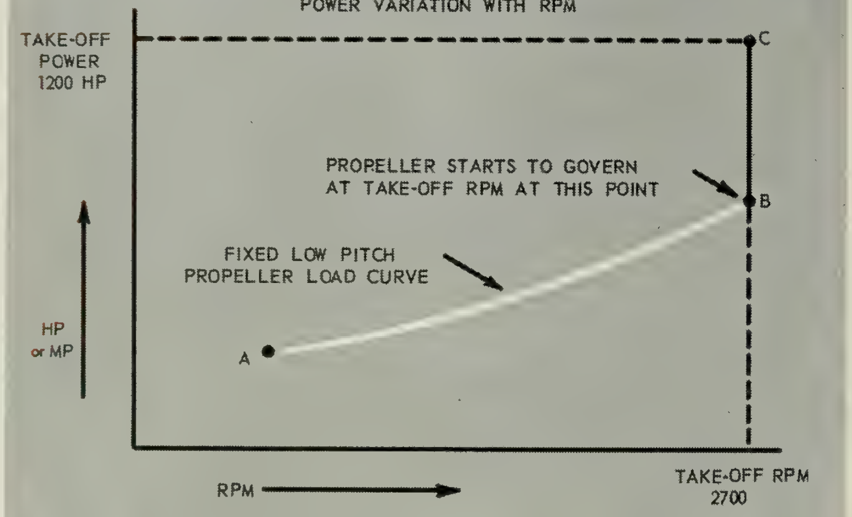
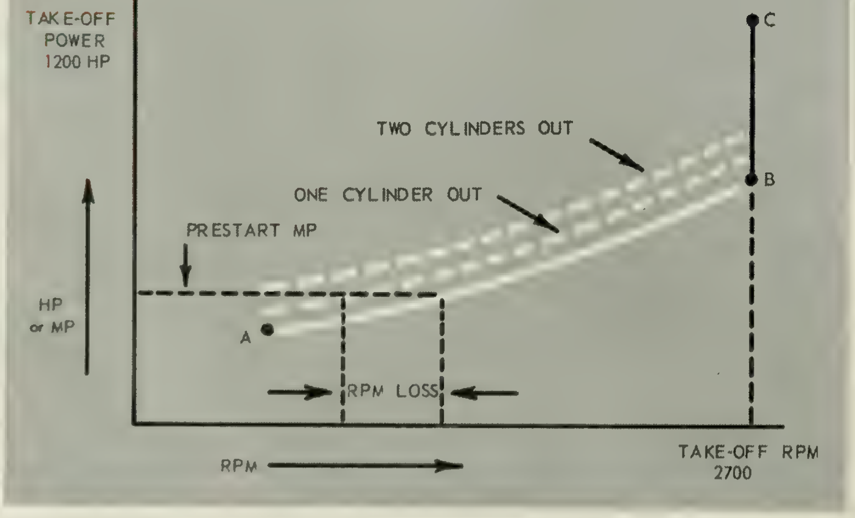


FIG. 2
EFFECT OF POWER LOSS



A power check at prestart MP fall well within the portion of the curv between "A" and "B". Engine operation at 40″ MP (or any other hig MP resulting in governing at 2,70 RPM) does not constitute a powe check.

Figure 2 shows how a higher manifold pressure is required throughou the whole "propeller load" range t obtain a given RPM if one or mor cylinders are not firing.

A partial loss of power from several cylinders, because of loss of compression or for any other reason would show up in a similar manne but no power loss would be eviden once "takeoff" RPM was reached. I other words, when operating at 2,70 RPM which is the takeoff RPM fo the C-47 airplane equipped wit R-1830 engines, it would not be possible to tell whether 40″ MP was giving 1,000 HP or 800 HP.

The 200 HP difference would result in a different propeller pitch setting as provided by the governor bu there would be no difference in th instrument readings as long as th propeller was governing at 2,70 RPM. Again, operation of the engin in the takeoff RPM range does no provide a true power check.

One of the basic fallacies evidenced from time to time is the belief that a standard mag check with RPM drop within tolerances is an accurate measure of overall engine dependability. RPM drop alone is not a reliable criterion.

A satisfactory ignition check must show that the engine is operating smoothly in the single mag position as well as show that RPM drop is within allowable limits.

For these reasons a more thorough mag check procedure is suggested, employing standard techniques. Time at each single mag position should be at least four seconds with special attention devoted to estimating fast or initial drop as well as the total drop.

The fast or initial RPM drop is generally indicative of the condition of the spark plugs and ignition harness.

The slow RPM drop following the fast drop indicates possible inaccuracy in distributor finger or magneto timing. This sensitive mag check, if properly employed in combination with an accurate power check, will give an accurate indication of engine condition. ●

# FICKLE FATHER TIME

Keeping polar time can be a complicated task for pilots and navigators who fly over or around the North Pole.

**By Lt. Robert C. Johnson**

A FAVORITE QUESTION of aircrews flying over the North Pole is, "What time is it?"

This question always gives rise to debate because it is possible by flying a tight circle around the Pole itself, to fly through a twenty-four-hour time period in a few minutes. If, when one arrives there, for example, the sun happens to be over the 90th Meridian which runs through Memphis, Tenn., then in Memphis it is noon, and while we are approaching the Pole in that meridian, we're in that same time zone and it is noon for us, too.

But simply by turning 90 degrees to the left we can be on the Greenwich Meridian where it is six o'clock in the evening. Continuing left we pass meridians rapidly which, like spokes, radiate outward from the hub of a wheel. Every 15 degrees it grows an hour later and the second quarter turn takes us past midnight. Then we're over the International Date Line where it is six o'clock in the morning of *the following day!*

Another half minute of turn at the same rate brings us back to 90 degrees at 12:02 Memphis time for a sort of world's record—around the world in two minutes! Or, suppose that instead of circling, we fly straight across the Pole itself, from Memphis meridian to 90 degrees E—incidentally, flying from, say, Friday to Saturday. Then in a few seconds and without turning the airplane a hair, it is no longer noon in the new time zone, but midnight.

All of this led me to rap my knuckles sharply against my forehead on my first flight or two and mutter, "Just what the heck time is it here, anyway?" But after some head-scratching, I came up with an answer which, although it may never rank with the Theory of Relativity, is quite satisfactory to me. I shall be gravely disappointed if no one ever asks me what time it is at the North Pole right now, for I look forward to the expression on his face when I ignore my watch and judiciously consult the nearest calendar.

## Ides of March

If the date should happen to be the fateful Ides of March, I'd answer: "Why, six o'clock in the morning, sir;" while on the 4th of July I would reply: "Oh, a few minutes after noon." And so it is.

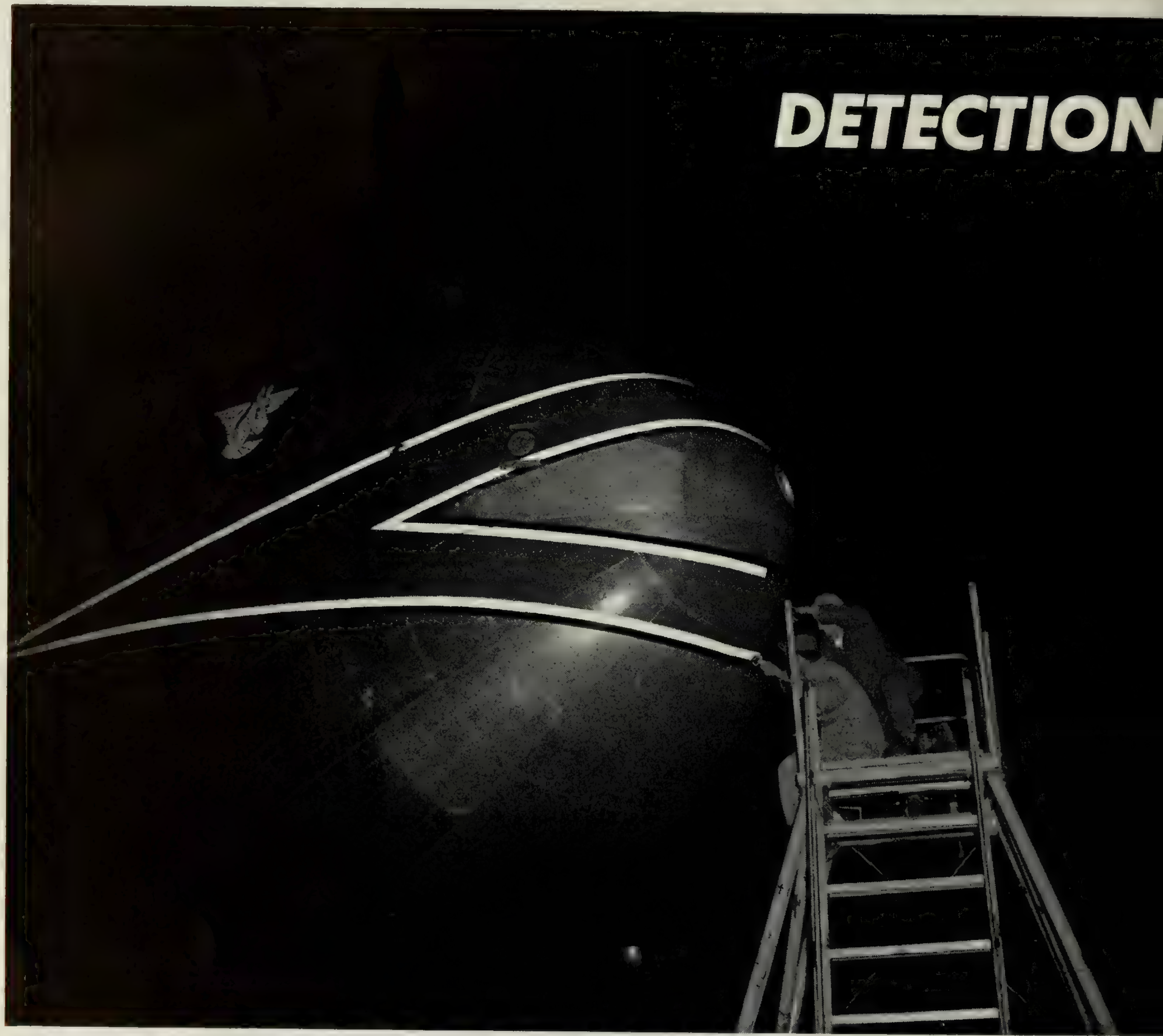
In March the sun hangs just below the horizon and gives a wide band of twilight. It is actually just before sunup there—for about a month. And on the 4th of July, having climbed to the monumental elevation of 23.5 degrees on the 21st of June, it has begun to slip downward a little, and so no matter how many jewels are in your watch, which at the moment is pointing straight at 8:20 P.M. or some such hour, at the Pole on July 4th, doggone it, it's a little past noon —or is it?

Or, should this not be too clear, consider a plane as it flies its weather run from Eielson AFB. Leaving the Eielson runway at 1500 hours of a certain day, the aircraft arrives at the International Date Line shortly after passing Nome, some four hours after takeoff. This, of course, puts it into tomorrow. From then on, today's mission flies along tomorrow, going on to a point past Attu, at the end of the Aleutian Chain. There it turns around and returns along a more southerly route, flying back toward today.

Approximately 10 hours after its original takeoff, it arrives at the International Date Line again and theoretically flies back into yesterday, if you consider the day they had been flying in all the time as "today." However, another complication sets in at that point. Ten hours after a 1500 takeoff would naturally put them at 0100 the next morning, or in tomorrow, even though you figure it on the "today" side of the Date Line. Therefore, upon crossing the Line, the puzzled crew finds that yesterday has gone into the limbo of history, to be replaced by today, which was tomorrow yesterday.

The astounding fact then comes to light—they had been flying in the day after tomorrow all the time and never even knew it! ●

# DETECTION



Crew chief fits band of reflective tape around the nose of a C-124. Material is self adhesive and flight tests prove that it w
stand up better than paint. Lower photos: Taxiing aircraft are able to judge wing clearance and reflectors give reference poi

# through REFLECTION

By Major W. H. Maxwell, Flying Safety Officer
and Capt. Keith G. Robison, 4th Troop Carrier Squadron,
Larson AFB, Washington

THE night is as black as the inside of McCarty's coal scuttle. You are a vehicle driver; behind you in the carry-all is the crew of a 4th Troop Carrier Squadron C-124. You start for the parking area and the aircraft commander tells you, "my airplane is zero-nine-six." But to you, all cats are gray in the dark and the huge hulks all look alike in the blackness of the ramp.

Suddenly the aircraft commander flicks his flashlight ahead and to the right. There's a square of silver light, and staring you in the face, right on the nosewheel door, are the numbers "096." Looks like neon, it's so bright, but actually it's a scotch-lite reflective sign. In a matter of seconds you deliver the crew and start back to Operations. No milling around the area, driving within a few feet of each airplane to squint at numbers.

★ ★ ★

You are an aircraft commander, going carefully through your preflight checklist. In the cockpit, the trim tab indicator says NEUTRAL. Controls are free and easy. Your scanner is in the tail position checking with you on interphone and calling out the actual position of the tail surfaces. As the rudder swings right to left, a bright patch shows up when the rudder is in full travel position. As the trim-tab is rolled up and down, another patch of silver glows in the dark. The scanners' flashlights pick up the small squares of reflective tape at these critical points. If you can see the silver tape reflecting, your controls are free, because they show up only when the control surface moves to full position. Because the C-124 is "flown primarily with the trim tabs," this check is extremely important.

★ ★ ★

You are making your first trip at night in the left-hand seat. Cripes, how glad you are to get out of the "idiot's corner." Sitting next to you is the IP, and you know he's watching every move you make. So maybe you *are* a little jumpy . . . just a *very* slight case of "check-itis."

The ramp is crowded. On each side of the parking strip long lines of airplanes loom silently in the night. Even with the aircraft parked exactly on their parking spots you know that you are going to be close, but how close?

But when you taxi out, it's "negative perspiration" . . . for each parked airplane is striped, nose and wingtip, with reflective tape. You know every minute how much clearance you have. The heater pods of those C-124's stand right out in the night. Each pod has a cone of silver reflective tape wrapped around the aft section, and a four-inch band of silver around the forward section. The two are joined by a horizontal four-inch strip.

The nose section of each airplane is striped by curving horizontal strips of reflective tape, in the color of the respective squadron. Looking like whale-mouths on the noses of the C-124's, these strips warn against taxi collision, and serve as squadron identification markings.

Further development of the wingtip markings, probably stripes of reflective tape inboard of the wingtips on the top surface of the wing itself, are intended to serve as reference points for formation flying. By having a wingtip light deflector shine a beam along these wing strips, pilots flying "in the slot" can tuck in closely in night formation and have a good margin of safety. Because of the angle of deflection of the scotchlite tape, only the man in formation can see the reflection. If he is three degrees from "dead-on," the reflection ceases. Because of this factor, the reflection is

**Col. Richard Jones, Commander of the 62nd Troop Carrier Group (H), gets briefing by Lt. Col Jerome M. Triolo, commanding 4th Troop Carrier Squadron, on fine art of taping up wheel door. (Night Photo)**

not readily visible to enemy observers.

Conversely, the reflective markings make identification by friendly aircraft easier. With the tape causing tail numbers to shine like a good deed in the night, interceptors need not fly dangerously close to any transport in order to identify it. With reflective tape on the tail numbers, a flick of the landing lights from a quarter-mile away will offer ready and positive identification.

An additional job of reflective marking is acceleration of troop marshalling when large numbers of personnel are to be loaded at night. The wing and gear-door numbers, reflectively taped, eliminate the necessity of airlift personnel hunting up and down the line to find the proper airplane. Loading time is reduced materially, to say nothing of reducing the accident potential of personnel carriers cruising up and down the loading ramp.

Where was this simple and inexpensive idea born? Why, up in the Moses Lake country, where the 62nd Troop Carrier Group (H), hang their hats. It seems that one night, after a black-out scramble that was slightly confused, it was apparent that some means of identifying airplanes in the dark was definitely required. Lt. Col. Jerome M. Triolo, commander of the 4th Troop Carrier Squadron (H), spearheaded the reflective tape idea, which has all the earmarks of growing into a real dollar-saving operation for the Air Force. Triolo, gathering his people around him, said: "Why not illuminate the strategic parts of the airplanes with reflective tape?"

Before the sun set that day, a C-124 was striped along the nose section, wingtip heaters and tail cone. Exhaustive tests were made with flashlights, aldis lamps and aircraft taxi-lights, and each method of lighting lit up the extremities of the airplane with amazing brilliance.

It was found that an aldis lamp or flashlight illuminates the serial number of an aircraft covered with reflected tape from a distance of 200 yards. By using silver tape, a reflection 220 times that of an ordinary white painted surface or the ordinary silver surface of the aircraft fuselage, is effected. Other reflection values for variously colored tapes are:

**Yellow:** 75 times brighter than white painted surface.

**Red:** 60 times greater than white painted surface.

**Green:** 30 times brighter than white painted surface.

**Gold:** 140 times brighter than white painted surface.

The question has been raised, "How long will this stuff stick on an airplane?" The 4th Squadron has one C-124 with more than 100 flight hours on the reflective tape. The nose paint has peeled off, but not the tape. The reflective tape is rainproof and windproof. It reflects in weather under clear ice, and under water. Frost will not adhere to it. Even i inclement weather it can be seen fro one mile out, or from 5000 feet altitude.

**Outboard strip of reflective tape and cone of tape about trailing tip of heater pod serves two purposes.**

The cost factor involved is extremely interesting. Total cost of illuminating a C-124 (and a C-12 takes a lotta huggin' and a 'chalkin') is less than forty dollars. It take about 20 man-hours to install the reflective tape. Balance these figure against the cost of one wingtip heate assembly plus 80 man-hours for installation and see what a fine saving has been offered Mr. Taxpayer.

High-ranking commanders wh have seen the reflective tape experiment are favorable in their reaction. General John K. Cannon, Commander, Tactical Air Force; and Major General Robert W. Douglass, Commander, 18th Air Force, have encouraged further experimentation. Brigadier General H. W. Bowman, Commander of the Troop Carrier Wing at Larson AFB, has enthusiastically backed the program. Colonel Richard Jones, commanding the 62nd Troop Carrier Group (H), has been interested to the point where he has actually supervised many of the experimental applications.

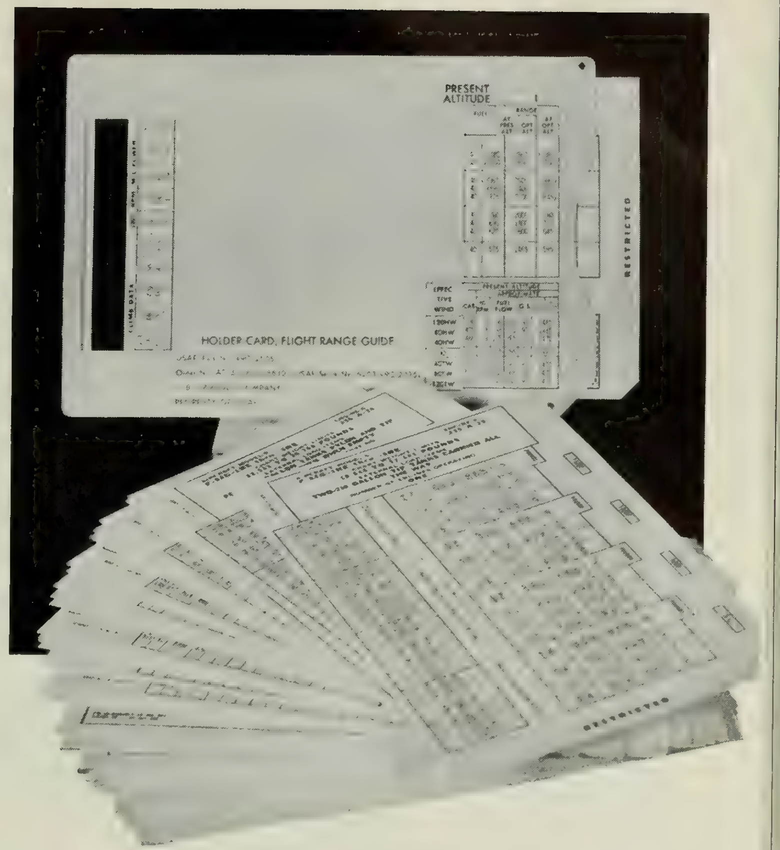
In addition to the use of reflective tape for aircraft markings, Lt. Col. Triolo has some very progressive ideas on airstrip lighting. Based upon his experiences in Korea, Triolo feels that runway lights and other airfield markings can adopt the reflective tape idea. He feels that by using reflective markings on forward airstrips, man-hour expenditures on lighting maintenance would be eliminated.

Says Triolo: "By covering an inverted cone the size of a Number Ten can with scotchlite and placing it on a stake to raise it above the ground, you have a marker every bit as brilliant as a light of comparable size. In fact, all electrical airfield lighting equipment could be eliminated for forward landing strips, without sacrificing one iota of the safety factor. Even drop zones and landing zones could be outlined with reflective markers by pathfinder teams, quickly and positively."

The safety-conscious personnel of the 4th Squadron feel that the reflective tape idea is good enough to be passed on to other units in the USAF. They say it pays off big in dollar savings and makes it easier on the men who do the flying. ●

*when you're crowded in the cockpit use a . . .*

# FLIGHT RANGE GUIDE



IF YOU'VE EVER SAT in a fighter cockpit, stick between your knees, trying to change your flight plan with the aid of a dog-eared, well-thumbed handbook, you will appreciate this information on assistance currently available through your normal supply channels.

Engineers at Wright Air Development Center have come up with a scheme that presents the data you need, neatly laid out and requiring minimum effort on your part. They've printed on laminated vinylite plastic cards all the cruise control data found in the Handbook of Flight Operating Instructions. These cards slip into a plastic holder which "windows-out" the applicable data.

The whole thing goes into a canvas wallet-type case small enough (5" x 7") to be carried in the pocket of your flying suit for easy reference during flight. This gadget, called the Flight Range Guide, contains all the data necessary for you to plan your mission and is compact enough to be invaluable for in-flight operation.

Each set contains data cards which give the available range and the operating instructions at eight different altitudes for various airplane configurations and weights. Data are included for all combinations of weight and altitude normally encountered during flight. The reverse side of the card contains climb and descent charts for the weight and external load noted on the face of the card. If you're flying a multi-engine airplane, you'll find reduced power engine data there, too.

To use these cards in obtaining range and operating information, the pilot simply selects the appropriate card, inserts it in the holder, aligns his desired altitude in the "altitude window" and reads the desired data directly below. Simple instructions are printed on the holder, although to get the most use out of the data it is suggested that you get pretty well acquainted with the introduction to the Appendix I "Cruise Control" Section of your Flight Handbook.

### Extra Cards

Auxiliary cards, not designed for use in the holder, contain data for takeoff, combat, landing, airspeed calibration, etc.

For instance, if you're flying a plane like the F-84F, you'll find that the stack of cards is pretty thick—61 cards, to be exact! This isn't done to load you down, but just to cover adequately all the different combinations of external items — bombs, tanks, rockets. For any given flight, weed out the ones that are not applicable to that particular flight and you'll have to carry only a half dozen or so.

In addition to other advantages, the cards are durable, washable and very legible. There's even an area on the holder which provides a suitable writing surface for any necessary calculations.

These Flight Range Guides are available in stock for every jet fighter currently in service use by the Air Force and for a couple of light jet bombers.

How do you get them? Simple. The cards are contained in the Technical Order system. Their identification number is simply the flight handbook number with the letters "FR" replacing the "TO." For example: FR01-15FDC-1 is the F-89C Flight Range Guide.

Have your Base Air Inspector order them the same way he orders your T. O.'s. Once you're on the list, you'll receive automatic distribution for all revisions. The holders and cases are in supply class 05A and are available through normal supply channels.

Any comment or complaint on the Flight Range Guide or the Flight Handbook, such as use, distribution or the data included, should be forwarded to the Commander, Wright Air Development Center, Attention: WCOSF (Flight Data Branch), Wright-Patterson AFB, Ohio. ●

# some like it COLD

By Deric O'Bryan, Ph.D., Chief, Arctic Section, ADTIC, Maxwell AFB, Ala.

*Dr. O'Bryan has traveled extensively in Finland, Alaska, and in the Canadian Arctic, and is the author of various articles on anthropology, survival and arctic survival. He was a member of the Bob Bartlett Arctic Expedition, 1927; leader of the Mill Island Expedition, 1951, and an official observer on "Exercise Warm Wind," 1952.*

SURVIVAL is living on the means available under emergency conditions.

In the Arctic this is a tough assignment, as the means available are few and far between. But it can be done. The first step is to analyze the dominant characteristics of the Arctic. This knowledge is the basis of preparedness for survival in the world's largest icebox. From then on, with all the survival techniques and equipment available, the harsh implications of survival are lessened. After all, the Arctic is home to thousands of Eskimo, Norwegians, Finns, Lapps, Samoyeds, Yakuts, Chukchi and to tens of thousands of Russians.

Each person who uses the term has a different concept of the Arctic. Airmen may remember it as a paradise for hunting and fishing, or as a cold hell. An engineer may think of it as the region of permanently frozen ground, the permafrost zone. A physicist is reminded of intense magnetic disturbances and auroras. An astronomer visualizes the polar area where the midnight sun is visible at least one day each year. A botanist pictures the lands north of the limits of tree growth.

However, most meteorologists and geographers think of the Arctic as "the region where the average temperature of the warmest month is less than 50° Fahrenheit." This condition is in general acceptance and is used by our Department of Defense as the basis for a definition of the Arctic.

The airplane has consistently lessened the remoteness of the Arctic since the 1920's. In this day of great circle routes, civilian and military craft alike fly over the Arctic. The polar regions have become increasingly important to our Air Force, reflecting the precept that a military organization must recognize potential enemies and plan accordingly. Most of the short-flight routes between the

**Far Northern traveling and camping are for those who like it cold. The camp at right needs some snowbank windbreakers around the tents.**

United States and the Soviet Union pass over polar regions. Quite properly most military operations and the command responsibility for Arctic regions are the concern of our Air Force.

### Arctic Characteristics

Cold, isolation and seasonal extremes of daylight and darkness are all dominant characteristics of Arctic environment. These conditions prevail far south into sub-Arctic areas; in fact, temperatures there range lower than in the true Arctic. It is difficult to draw a hard and fast line between an outing in the northern woods and an Arctic survival experience. A summer day in Baffin Island is far less rigorous than a Christmas blizzard in South Dakota, but here the factor of isolation is paramount. Baffin Island settlements can be counted on your fingers. By comparison, South Dakota is a maze of heated restaurants.

A workable compromise between the Arctic, polar regions and cold weather areas is achieved if we consider, for the purposes of "arctic survival," all those northern localities likely to have one mean monthly temperature below 14° F. and less than one person per square mile.

A rough demarcation of the area so defined is latitude 60° North. This part of the world includes the Arctic Ocean which is ice-covered the year round. It includes the tundra, those level or slightly rolling treeless wastes which separate ranges of majestic mountains and occasional icecaps. It includes northern extensions of taiga, the forests of larch, spruce and birch which cover the areas intervening between the "high latitudes" and our homeland of familiar trees and fields. Physiographically, the diversified areas have one thing in common—a cool climate.

Cold is a miserable condition unless you are prepared to enjoy it. Very low winter temperatures occur when a locality is far from the equator, far from an ocean and in a lowland or valley bottom. The moderating influence of the Arctic Ocean, even through a film of ice, holds minimum temperatures at the North Pole to about −60° F. In contrast, inland areas of the sub-Arctic often are much colder. Verkhoyansk, near the Arctic Circle in eastern Siberia, has long been thought of as the Cold Pole, having been chilled to a record of −94° F. Recently, a temperature of −87° F. was recorded near the center of the Greenland Ice Cap.

To be hot in summer, again an Arctic locality must be far from the cooling effect of oceans. Temperatures rarely exceed 60° F. along Arctic coasts. Inland localities at similar latitudes occasionally warm to 100° F.

Cold, and here I mean an annual prevalence of freezing temperatures, causes a number of conditions in the physical environment which present problems to a survivor.

### Plant Foods Covered

Ice and snow prevail from October to July. Plant foods are blanketed with snow. Many animals hibernate or migrate south. Fresh-water fish are shielded by the ice cover. Soft snow impedes movement, unless snowshoes or skis are at hand or improvised.

Frostbite is the freezing of any part of the body; this may be accelerated by wind-chill (Fig. 1). Frost-burn results when flesh comes in contact with metal under freezing conditions. In spring and fall, the sun's rays are reflected from the snow surface and may cause snow-blindness or extreme sunburn.

On the credit side of the ledger, ice and snow provide potable water everywhere. Blocks of naturally compacted snow make an excellent shelter—the igloo of the Eskimo. Snug quarters may be excavated in a snowdrift.

Although the number of animals is limited, they are quite vulnerable. Land animals leave tracks and may be snared at burrows or trapped in runs. Several species of seal breathe through blow holes in the ice which are found under small domes of crusted snow. A short wait may be rewarded by hooking or harpooning a hundred pounds of nutritious meat.

Signal panels, dark smoke and the wrecked plane itself are plainly visible during daylight. Although accidents are commonplace, illnesses are rare. Germs do not thrive in cold.

The feeling of isolation is common to most Arctic localities away from the few established lines of communication. Chances of local help are extremely slim in Arctic regions. The solitary survivor or downed crew are all alone except for the possibility of radio contact with Air Rescue Service.

During the survival period, life is an interaction between fear and discomfort on one hand and self-assurance and capability on the other. Self-assurance is a matter of temperament, but it may be strengthened by experience and instruction. Capability results from intelligence, ingenuity, good training and common horse sense.

Isolation during the survival period may not be relished by Arctic survivors but it is an actuality that must be faced. Like a bald head or double dentures, not much can be done about it. Actually, you do something about it if you are isolated for an evening at home. Perhaps you read a book. As a survivor, you could do worse than read the survival manual and then find some of the animals and identify some of the edible plants described and illustrated.

Seasonal extremes of daylight and darkness result from the tilt of the earth's axis. Arctic nights are long, even continuous in winter; conversely, north of the Arctic Circle the sun is visible at midnight at least once a year.

### Depressed Moods

Darkness presents a number of problems to the Arctic survivor. No heat is received directly from the sun in mid-winter, thus the cold reaches extremes. Outside activities are curtailed of necessity, although the light from the moon, stars and auroras, shining on a light ground surface, is of some help. Confinement to cramped quarters adds boredom to discomfort, and depression becomes the dominant mood as time drags on.

Without daylight, rescue by airplane is almost out of the question. A few moonlight landings have been made on frozen bays, and airdrops have been provided camps marked by flares or fires. Fortunately, the period of complete darkness does not last long.

Several other conditions, restricted to Arctic regions or of frequent occurrence there, have bearing on survival. A white-out may complicate a survival situation; more often it causes the accident which makes survival necessary. When the ground is snow-covered and the sky overcast, when light reflected by the snow has an intensity equivalent to that received from the sun, a white-out is the result. Everything seems hazy and looks milky. There is no horizon, no shadow, nothing to aid in judging distances. A man on the ground has to probe his way. Pilots have made unpremeditated landings on the Greenland Ice Cap.

Radio fade-outs in the Arctic are caused by solar explosions and sunspot periodicity. The accepted theory is that the sun emits electrified particles which produce heavy ionization on reaching the earth's atmosphere. This ionized blanket disrupts radio ceilings everywhere, but particularly in the polar regions. Long-term fade-outs may last for several weeks. As these are referable to sunspot activity, they may be forecast.

Short-term fade-outs, caused by solar explosions similar to the detonation of atom bombs, may occur in

**Above is an SA-16 Rescue plane in a "white-out." At right a little shoveling and they survive in comfort. A good shelter is a basic survival requirement.**

the Arctic both during daylight and darkness. The atmospheric disturbance is manifest about eight minutes after a solar explosion. The fade-out condition lasts from 15 minutes to several hours. It cannot be forecast. By blanketing radio reception, fade-outs are of obvious concern to survivors. Radios are unserviceable and communication leading to rescue may be delayed.

Magnetic variation is noticeable almost everywhere. A compass needle points to true north only from positions due south of the Magnetic Pole, or along the longitude on the far side of the North Pole from the Magnetic Pole. The peculiar condition in the Arctic is the enormous variation, up to 180° between the Magnetic and North Poles. A survivor who decides to travel between established points must know and allow for the local magnetic variation.

When the important environmental characteristics of the Arctic are recognized, the major conditions for survival become self-evident or can be surmised. For example, temperatures range from cool to frigid. An in-flight emergency may eject an airman from a warm plane into a barren waste of snow. To survive, he will need more than a T-shirt and tennis shoes. It is self-evident that warm clothing is essential to survival.

The same simple reasoning results in emphasizing the need for shelter. Figure One gives us this information: With a temperature of $-5°$ F., and a breeze of eight miles per hour, "travel and life in temporary shelter becomes disagreeable." Look what happens when it chills to $-30°$ F., and the wind speed doubles.

Fortunately, strong winds are rare in polar regions. The inland areas and the Arctic Ocean are among the most placid localities in the world. Sometimes strong winds sweep along the coasts and winds of gale velocities occur where a plateau descends abruptly to the ocean—as along the coasts of Greenland.

It can be surmised that food, lots of it, is essential for survival in the Arctic. The colder it is, the more rapidly heat is dissipated. The source of body heat is the food one eats. More food is needed to compensate for the accelerated heat loss in cold climates.

This method of studying cause and effect is one way to acquire knowledge for Arctic survival. Another method is to analyze the records of actual survival experiences. "Down in The North," a publication of the Arctic, Desert, Tropic Information Center, does just that in a review of what happened to the passengers and crews of some 268 planes, after they bailed out or crash-landed in the Arctic. Some interesting conclusions become apparent from the analysis.

It is far better to crash land than to bail out. The parachutist is alone for a worrisome period when physical injury is a possibility, and he may be unable to re-assemble with his fellow crewmembers. A jumper cannot carry much survival gear with him, and he is separated, permanently in most cases, from all the usable equipment in the plane, which may be lost or burned.

It is far better to stay put than to attempt to journey any distance in a rubber dinghy. Life rafts have and will continue to get men ashore from a ditching, but the record is zero for successful along-shore dinghy travel. Evidently the waves, or the wear and tear from ice or rock abrasion, soon make the rubber rafts unserviceable.

### Information Available

The very best method of appreciating the equipment and techniques essential to Arctic survival is on-the-job-training. Not all have had this privilege, but the information is available at second hand from evaluated experiences of the many men who have enjoyed living in the Arctic for months or years at a time.

Results from all of these methods are considered by the Air Force in establishing Arctic indoctrination courses and in preparing the authoritative manual 64-5 on "Survival" in all non-temperate environments.

The major conditions for Arctic survival are self-evident. But clothing, shelter and food cannot be dismissed with a paragraph each.

Clothing is confining. The more you put on, the more confining it becomes. Conceivably, when it is desperately cold, you could weight yourself down with scarves, sweaters, trousers, socks, and other insulating materials. This cumbersome assortment might keep you warm, though immobilized.

Specialists have combined our technical versatility with the tried and true styles of Eskimo skin garments (double parkas and double boots) to achieve a workable garb. Arctic clothing is scientifically designed and carefully fitted to provide insulation and ventilation while remaining reasonably lightweight.

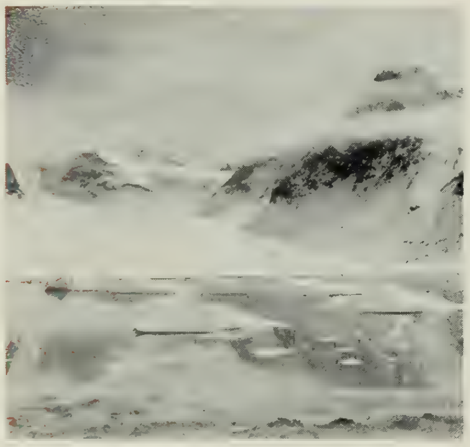
The multiple layer principle of several layers of medium weight cloth in place of a single heavy garment allows for a windbreaker (to counter wind-chill), for the addition of more clothing to meet increasingly low temperatures and for easy replacement and quick drying of inner or

**Driftwood may often be found strewn along most Arctic coasts. Below, right, polar bear meat can supplement survival rations.**

outer layers as perspiration or precipitation lessens their efficiency.

Footgear is a subject in itself. Shoes or boots must be large enough to permit the wearer to put on several pairs of wool socks without pinching, yet small enough to prevent rubbing blisters, and they must be water-repellent. With an assortment of mukluks, shoepacs and other prescribed footwear available, an occasional character appears at an Arctic base in low-cut oxfords. Survival accounts contained gruesome details of what happened to lads who crash-landed in office shoes (these often snapped off in descents by parachute). Frostbites leading to amputations were commonplace. The miserable wretches spent their survival periods with their feet wrapped in cloth strips padded with moss.

**Cold country landscapes look like this along the shores of icy Greenland. . . .**



**. . . and like this aerial view of a wooded section along the coasts of Labrador.**

It is Air Force policy to keep the plane cool enough, when flying in the Arctic, to permit the wearing of suitable outdoor clothing. If an emergency arises, at least the men are properly clad.

Shelter permits needed rest. At a minimum it may be a parachute windbreak; by using ingenuity and effort, it can be a home away from home. A number of downed fliers evidently forgot, or never knew of, the insulating properties of snow. They chose the plane as the best available shelter and decided to wait it out in this windproof but cold-soaked compartment. Many of these individuals, when found by a rescue party, were frozen stiff.

A shelter by itself keeps out the cold but it does not guarantee a warm interior. Most Arctic survival kits contain burners for cooking and heating, and for melting snow and ice for water. All these burners use oxygen, so care must be taken to provide ventilation. Stove vents are needed to avoid carbon monoxide poisoning. A crack in the entrance and a small aperture in the shelter's roof provide enough circulation of air in the snuggest quarters.

### You Need Calories

Food is a physiological necessity and its presence or absence can bolster or play havoc with morale. Our Army conducted exhaustive studies on ration issue. It was determined that 3,300 calories per day is the minimum number needed by soldiers who are working moderately hard in a hot climate. Expose the same soldier to a temperature of 14° F., and he needs 5,200 calories per day. If it gets colder, he needs still more food.

This increase in the number of calories normally means an increase in bulk. Much experimentation has been undertaken to meet the caloric requirement for the Arctic in highly nourishing, yet palatable small-sized rations.

Two years ago I was without rations for three weeks because my "rescue" from an isolated Arctic island was delayed. Two little plants named lousewort (the root is edible) and sorrel (the leaves are like watercress) provided fresh greens; kelp furnished some bulk. The real staple was seal meat. Now seal is good. I still savor the thought of it. But th predominantly protein diet seemed t do little to ease hunger pangs. Afte just a few days, a daily intake of fou to five pounds of seal in the form o steaks, roasts, stews and soups wa needed to feel even moderately well fed (this was embarrassing at a late date, until my stomach shrank t normal size). When rescue brough access to scales, I was 16 pounds ove normal weight.

All this suggests that most men and every survivor, can and shoul talk themselves into eating the foo at hand when away from an a la cart menu. It is astonishing how thought dwell on good food when it isn' available. Thoughts are not bad, i they don't get the thinker down.

By now you either like the Arctic or it leaves you cold. As a potentia survivor you have a preliminar acquaintance with many of the conditions of the Arctic environment. Anticipating an inflight emergency, yo plan to wear the most suitable clothing issued and to have at hand th most appropriate survival kit available, as well as some supplementar rations.

All of these may prove useful. Suddenly you are on the ground in th middle of nowhere, but you have bee briefed on Arctic survival technique and you are well equipped. The out-of-door life agrees with you. Still yo don't plan to homestead the survival site. This introduces the allied subjects of communications and rescue.

There is a radio in the airplane and an emergency set in the survival gear. To insure speedy rescue, it is essential to communicate the best position or fix determinable, so the rescuers will know where to look.

Communication equipment, the instruction of personnel and Air Rescue proficiency have improved greatly in the past eight years. Nevertheless, the importance of a prompt and accurate radio report is self-evident.

### Signal Techniques

If the radio is destroyed and the emergency set is left behind, things are bad but not hopeless. There are such things as signal panels, signal mirrors, flares and sea marker—the powder tints a snow surface beautifully. If there is wood available (driftwood is stranded on most Arctic coasts), fires and smoke can be made. The wrecked plane is a source of

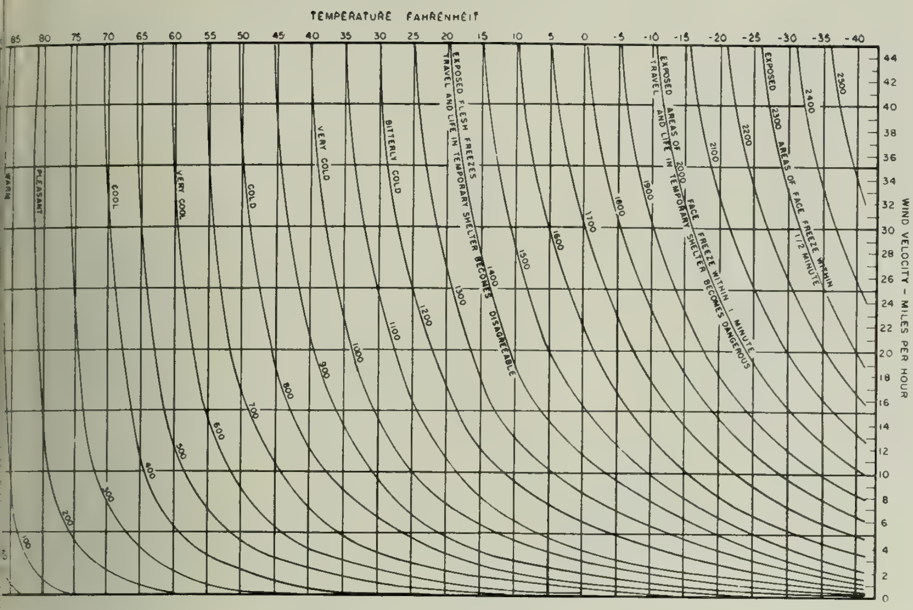


Figure 1. WINDCHILL NOMOGRAM

**The "wind chill" factor is an index that indicates the rate at which the naked human body loses heat when exposed to various temperatures and wind velocities. This chart shows that high winds in areas of low temperature have a decided effect on the rate at which the human body cools. Note that with a wind velocity of 30 MPH, your face will freeze in one-half minute at 27 degrees Fahrenheit.**

glinting surfaces and provides fuel for fires and smoke. Some survivors have signalled successfully by tramping out messages in the snow—even on the Greenland Ice Cap. The depressions show as shade in a sunlit surface.

Some individuals are just "natural born" survivors. They are stable, industrious, perceptive and self-sufficient. Others have trouble surviving in their home town. The Air Force is showing increasing concern in the screening of personnel for Arctic assignments. The Far North is no place for cripples, for sufferers from respiratory weaknesses, for men with poor circulation, for those allergic to wool or for the accident prone. The Arctic environment does not agree with neurotics, heavy drinkers, men with serious family troubles or maladjusted individuals. If these types are unsuited for assignment to Arctic installations, they most certainly are poor risks in survival emergencies.

Careful selection of personnel, thorough preliminary indoctrination and having and knowing how to use tested equipment, pays off in Arctic survival.

Nowadays most survival incidents are accounts of patience and planned activities to increase comfort, rather than of desperate makeshifts to keep alive. A World War II account of a C-47 down on the Greenland Ice Cap illustrates precisely how an inexperienced crew faced Arctic survival, and in contrast, what improvement the addition of two men trained in Arctic living made in the situation.

A C-47 crash-landed in mid-December. There were no injuries. The seven passengers and crewmembers succeeded in transmitting their approximate position. That was the substance of their constructive activity in the face of surface gusts up to an estimated 130 miles per hour and minimum temperatures somewhere around −50° F.

Airdrops of food and survival gear were made but the fearful seven recovered only a few of the packages. They simply huddled in their wrecked plane for four days and nights. The metal shelter could not be kept warm, even with two gasoline stoves and several layers of parachutes hung as an inner lining. They ate practically none of their rations.

On the fourth day a stripped-down B-17 attempting a landing, crashed near the wreck. This plane carried two crewmen trained in Arctic survival. These men knew immediately what to do. Their first action was the construction of a snow shelter. It was completed in three hours.

A plumber's furnace from one of the air-dropped packages provided a pleasant inside temperature of 60° F., in an additional half hour. Subsequent rescue attempts added the crews of two cracked-up gliders to the Ice Cap party. All were finally rescued with a ski-equipped C-47, fourteen days after the original crash.

By this time survival was being sweated out in comfortable hotel-like quarters. Two large sub-surface rooms had been excavated, stairway entrances constructed and parachute roofs secured in place. A tunnel connected each room to a subsurface, sheltered latrine. Another tunnel housed supplies, as airdrops provided more than was needed in food, clothing and sleeping bags.

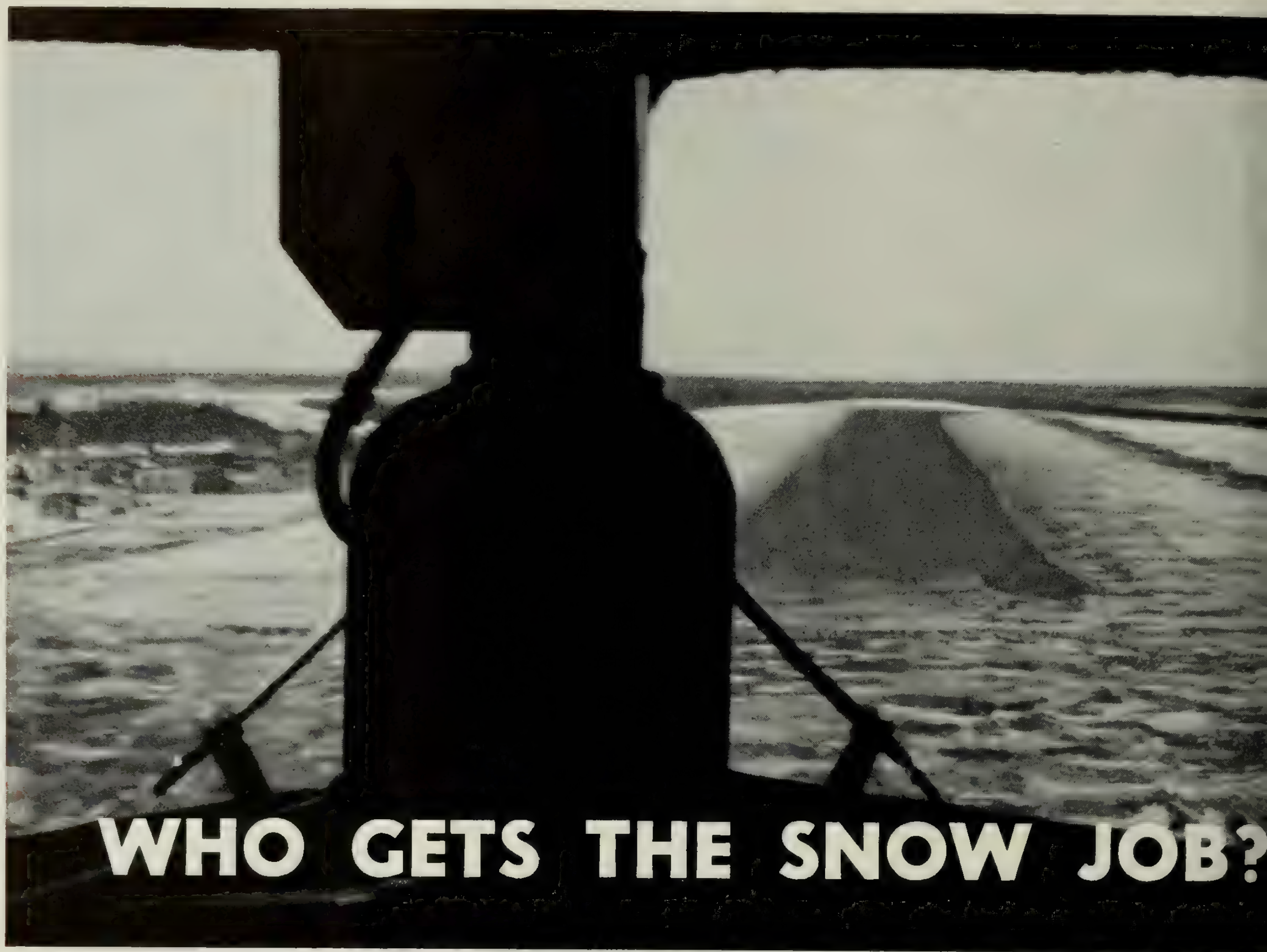
### Sleep in Comfort

Heaters were turned off at night but even then sleeping bags were comfortable only when stripped down to the summer liners. With heaters on in the day time, the men sat around in their shirt sleeves, usually in the room which was floored with a deflated life raft and lined with tarpaulins.

Gasoline was transferred to the stoves from the tanks of the C-47. The farsighted engineer of the B-17 had thought to bring a hand transfer pump with him. This able mechanic also thawed out and rigged the B-17's auxiliary power unit to supply electric light and radio reception to the hotel-bound survivors. An endurable Christmas was spent in warm comfort, listening to musical programs, gnawing on a pre-cooked turkey complete with trimming and in eating ice cream, provided on order by airdrop.

Primarily, survival in the North, as in other areas of the world, depends on two factors: in having the proper equipment with which to meet the survival problem and in knowing how to use it.

Preparedness, knowledge and courage in the face of an unfamiliar situation can bring you through the ordeal safely. ●



# WHO GETS THE SNOW JOB?

THE pattern of "snowbank" accidents is almost standard. The great majority of these snowbank collisions are pilot error, pure and simple. They are caused by lack of judgment, lack of planning and poor pilot technique. There is also another important factor present, that of supervision. Granted that the pilot must keep his eyeballs uncaged when landing at any airfield in winter, especially when there is snow cover; but planning of snow and ice removal from the facility itself is a definite responsibility of the commander and his operations officer.

If you expect two or more inches of snow at your base this winter, by now you should have set up your snow removal plan, as required by AFR 90-6, and as augmented by T.O. 00-105B-1.

The snow removal plan encompasses a great deal more than the actual clearance of snow from your taxiways, ramps and parking areas. Your plan must be carefully thought out, and coordinated with Operations and Installations. Contingent upon the removal of the snow itself are factors such as runway marking, protection of lighting fixtures, ramp and taxiway clearances, approach and clear-zone clearances and most important of all, a firm policy on flight operations. This last item should take into consideration the importance of your mission and whether or not flying should be shut down during periods of extremely heavy snowfall and attendant weather conditions such as sleet, ice, slush and ice fog.

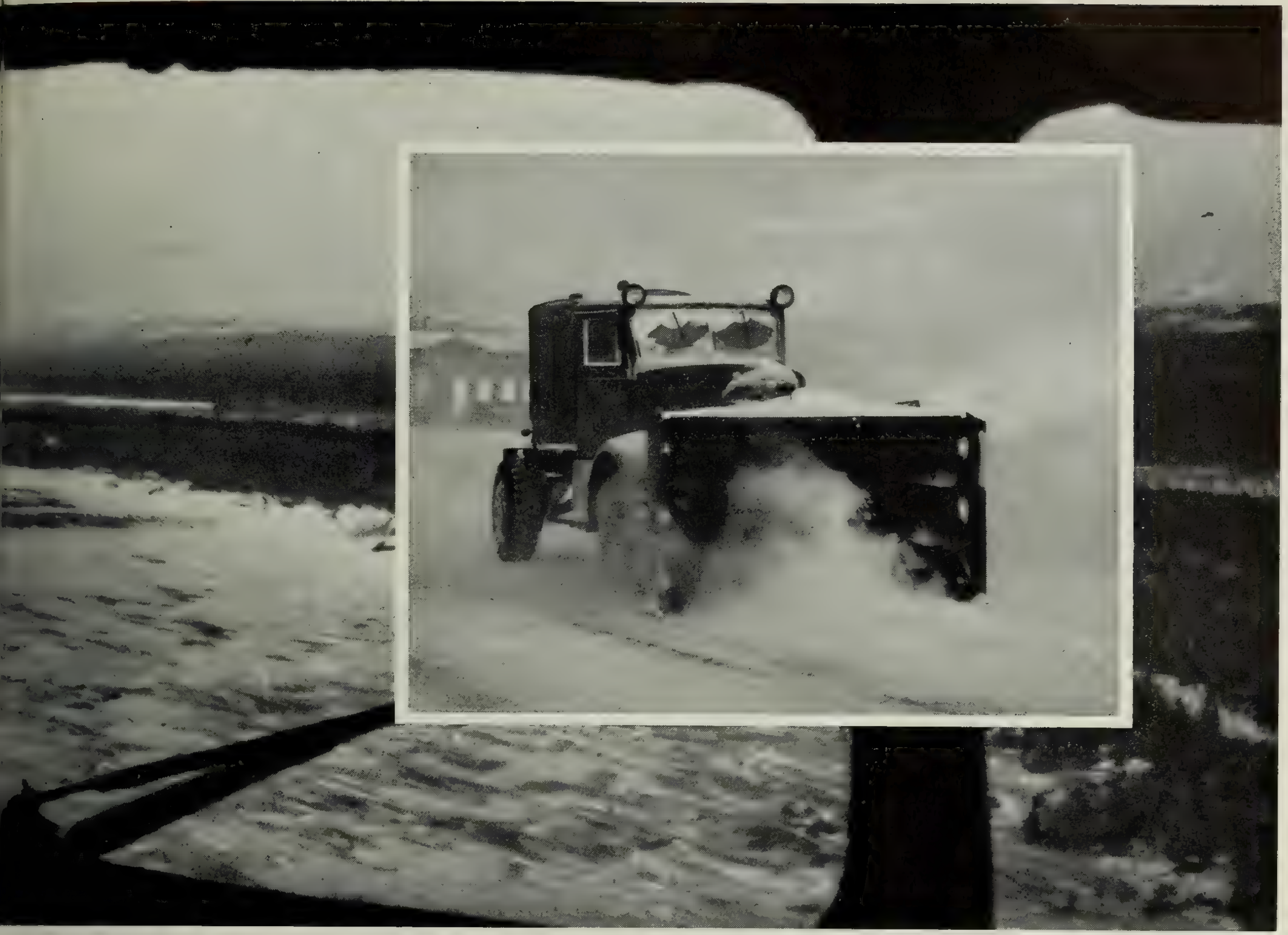
There are times when snow removal crews, with all the equipment they can muster, cannot keep up with heavy snowfall. Ice or slush on runways, taxiways and ramps, heavy enough to preclude all braking action, presents an accident potential with an extremely narrow safety margin.

Once you have your snow removal plan and its basic policies set in your mind, outline the plan in detail and coordinate it with Operations, Installations and Weather. Although snow removal is primarily the responsibility of Installations, Operations should have overall control wherever flight or ground movement of aircraft is factor.

Your plan should include a map o the airfield, actual areas to be cleared, and routes for snow removal equipment. The plan should also include an equipment list, showing the vehicles on hand, types of vehicles and capacities. Besure you not only have all the necessary equipment, plus spares, but that it is in serviceable condition.

In addition, have an emergency set-up on equipment so if you run into trouble you can borrow needed equipment from nearby municipal agencies. Remember, construction men are used to helping each other out of tight spots and you will find them more than willing to pitch in and help out when needed. Another important part of your plan should detail the number of civilian and military personnel assigned to snow removal, plus stand-by crews to help out in an emergency.

Tied in closely with your snow removal operations should be the Weather Officer. When snow is im-



pending, Operations and Installations should be notified automatically.

The Operations Officer should be the project officer, responsible for monitoring the snow removal and area marking program. Installations should furnish the "pick and shovel" work, but the overall problem should be closely controlled by Operations. At one Air Force base in the "deep snow" country, the snow removal crew works under the direct supervision of a snow removal foreman, who in turn works under the Operations Officer. The Operations Officer notifies Installations when he wants the snow removal crew to start, which is usually when the snowfall reaches a depth of two inches. The snow removal crew foreman operates from a radio-equipped jeep which is in constant touch with the control tower.

Have snow removal crews work together at all times in a manner similar to the aircrew system. Assign the same men the same equipment and keep the crew in a unit.

An important item in safe operation under winter conditions is a foolproof system of incident and near-accident reports, which requires all pilots taking off or landing at your base to report surface conditions of ramps, runways and taxiways. A pilot cannot always depend on weather reports or NOTAMS being absolutely up to the minute in stormy winter weather. Operations should keep a blackboard in the dispatch section, on which ground conditions are logged hourly, with the time of the last entry noted.

An important attendant factor to snow removal is the proper marking of runways, taxiways and ramp areas. At many bases in the North, these edges are marked with spruce boughs, erected at each runway light point and at other points spaced along edges of taxiways and ramps. They also give the landing pilot a reference point in "whiteout" conditions where perspective may be lost.

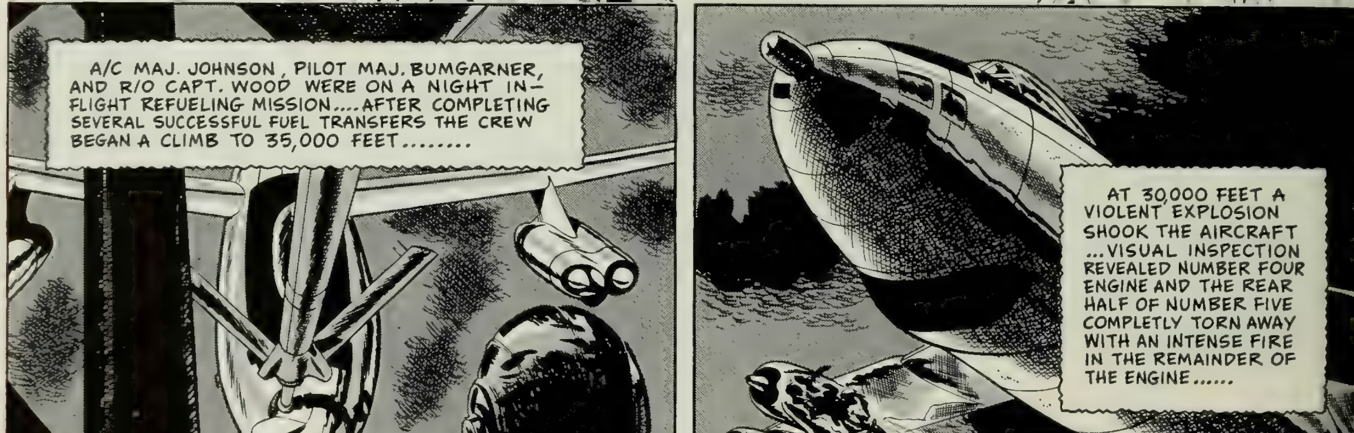
Another system in use employs sea-marker dye. The dye is mixed in the following solution: five parts water, five parts sea dye, one part alcohol. This solution is placed in a 55-gallon drum under pressure and sprayed on the snow. The edges of the runways are marked with a broad stripe, the thresholds of the runways are marked, and in certain instances a centerline is included. It is equally important that the edges of taxiways and ramps be marked.

Sand and ashes may be used instead of sea-marker dye, but the use of cinders should be carefully weighed when jet aircraft are involved, since clinkers conceivably can cause jet engine compressor damage. Sand in runup areas, especially where jets are concerned, is a must, providing it is evenly distributed, and compacted with a multi-wheel rubber-tire roller. As soon as the ice is under control, all excess sand must be removed with a power sweeper.

Remember that efficient snow control is a matter of teamwork and cooperation. Set up a workable snow removal plan and you'll find that your accidents, where snow on landing and parking areas is concerned, will show an appreciable decline! ●

# ANOTHER FIRST TEAM!

**Major Lawrence H. Johnson, Aicraft Commander.**
**Major Amon G. Bumgarner, Pilot (Center).**
**Captain Herbert H. Webb, Jr., Observer (Right).**


A/C MAJ. JOHNSON, PILOT MAJ. BUMGARNER, AND R/O CAPT. WOOD WERE ON A NIGHT IN-FLIGHT REFUELING MISSION.... AFTER COMPLETING SEVERAL SUCCESSFUL FUEL TRANSFERS THE CREW BEGAN A CLIMB TO 35,000 FEET........
AT 30,000 FEET A VIOLENT EXPLOSION SHOOK THE AIRCRAFT ...VISUAL INSPECTION REVEALED NUMBER FOUR ENGINE AND THE REAR HALF OF NUMBER FIVE COMPLETLY TORN AWAY WITH AN INTENSE FIRE IN THE REMAINDER OF THE ENGINE......
WELL DONE!
THROTTLES FOR ENGINES FOUR, FIVE, AND SIX WERE CUT, FIRE BUTTONS ACTUATED AND THE CREW ALERTED FOR BAILOUT... A DECISION TO LAND WAS DECIDED UPON WHEN THE FIRE IN THE AREA OF NUMBER FIVE WAS EXTINGUISHED........
UPON LOWERING THE GEAR THE RIGHT OUTRIGGER DID NOT INDICATE DOWN AND LOCKED.... THE CREW PREPARED FOR A CRASH LANDING... BUT A SUCCESSFUL THREE ENGINE LANDING WAS MADE WITHOUT ANY FURTHER INCIDENT... WELL DONE!

# CROSS FEED

## LETTERS TO THE EDITOR

### Amendment to 60-16

While studying the Flying Safety Magazine for June, 1953, it was noticed that on page 13 there seemed to be an error. Paragraph four of AFR 60-16 quotes paragraph 11, AFR 60-16 dated 13 Feb. 53. We have an interim change to AFR 60-16 dated 12 May 53 which states we should fly to the right along low frequency airways and down the centerline of VOR Airways. The message we received is: Hq USAF Message Number AFOOP-OC-FL ALMAJCOM 491/53, DTG 12/2016Z, May 53.

We would appreciate a clarification and/or correction in your article.

**Maj. Bernard W. Luster**
**Ops Officer, 1733d AT Sq**
**1706th ATGp, CNTLD MATS**
**Travis AFB, Calif.**

Flying Safety *Magazine went to press before the message referred to was received. Flying the right side of a low/medium frequency range is now directed by amendment 60-16A, dated 27 May 1953.*

• • •

### Where Is Your UHF Antenna?

Different types of aircraft have the UHF antenna installed in different locations, such as bottom or top of fuselage, wing tip, or vertical fin.

Since the UHF line of sight characteristics are straighter than those of VHF, it is likely that poor, or no communication will result if a large area of your aircraft is between your antenna and that of the other station. In trying to contact a control tower, for example, avoid shielding your own communication. Turn the aircraft if necessary so that there is direct line of sight between your antenna and the control tower antenna.

**Col. Robert L. Schoenlein**
**Asst Chief, Mgt Insp Div,**
**D/R&MI**
**10024 IG Group**

### Limitations of the Type B-2 Plotter

This Headquarters has been informed by WADC that the article in the Keep Current page of Flying Safety, June 1953, entitled "B-2 Plotter Error Found," is correct.

The plotter should not be used to measure distance on a USAF LORAN Chart from 0° to 60° latitude, as the charts in this range are Mercator projections. The LORAN charts from 60° to 80° latitude are Lambert conformal projections for which the 1:3,000,000 scale on the B-2 is valid.

The LORAN Chart for the polar region, 80° to 90° latitude, is a stereographic projection which, for all practical purposes, presents a constant scale of 1:3,000,000 within the limit of the chart. The 1:3,000,000 scale on the B-2 plotter is therefore valid for use only with USAF LORAN Charts in the range of 60° to 90° latitude.

The Center has initiated the following action to correct the error:

- Requested the status of the Type B-2 Plotter be changed from "standard" to "limited standard."
- Requested the master drawing and Fig. 1 of Specification MIL-P-5127A be revised to identify the 1:3,000,000 scale as "N.M. on USAF L. R. Nav. Charts (60° to 90° Lat.)."
- Requested that the corrected plotter be assigned the name "Type B-2A."
- Requested that the Type B-2A be assigned the status of "standard."

**Hq, Air Research and**
**Development Command.**

• • •

### Mid-Air Collisions

A few issues back, you discussed the hazards of mid-air collisions and pointed out that the greatest danger seems to be during VFR condition.

We have all experienced the momentary "thrill" of seeing the other airplane—just after it has passed a little too close—or have worried about the shadow of the airplane we can't seem to find. Around such busy places as Washington, New York, San Antonio, and Los Angeles, the problem will probably get worse before it gets better.

I have been kicking an idea around that may sound hairbrained but still may have possibilities. We never have any trouble seeing an airplane that is making a vapor trail.

Suppose we had a gadget a pilot could turn on in the control zone that would give off a pseudo vapor trail which would extend for about 100 feet behind the airplane and then vanish.

It seems to me this would increase the "see-ability" of aircraft by many percent and make VFR flying around busy airports indefinitely safer.

**Major D. E. Ballard**
**Sheppard AFB, Texas**

**Maj. Gen. E. L. Eubank, Commander of Technical Training Air Force, presents Col. Stanton T. Smith, Lowry AFB, Colo., with Flying Safety plaque. The award covered the last six months of 1952 and represents more than 19,000 hours of safe flying time by Lowry personnel.**

# Keep Current

## NEWS AND VIEWS

• **Aerial Tanker Tests** — USAF Air Research and Development Command has completed the first phase of tests designed to provide data upon which to base requirements for future high speed, high altitude aerial tankers and combat aircraft.

Two B-47 Stratojets were used in the tests. One, the "receiver" aircraft, was modified to mount a long, streamlined refueling probe jutting from its nose. The other, designated the K-47B, has an adaptation of the probe-and-drogue refueling system mounted in the bomb bay.

Modifications necessary to equip the B-47 as an experimental tanker include installation of the refueling equipment in the bomb bay, design and installation of the fuel tanks, pumps and lines and some additional cockpit instrumentation.

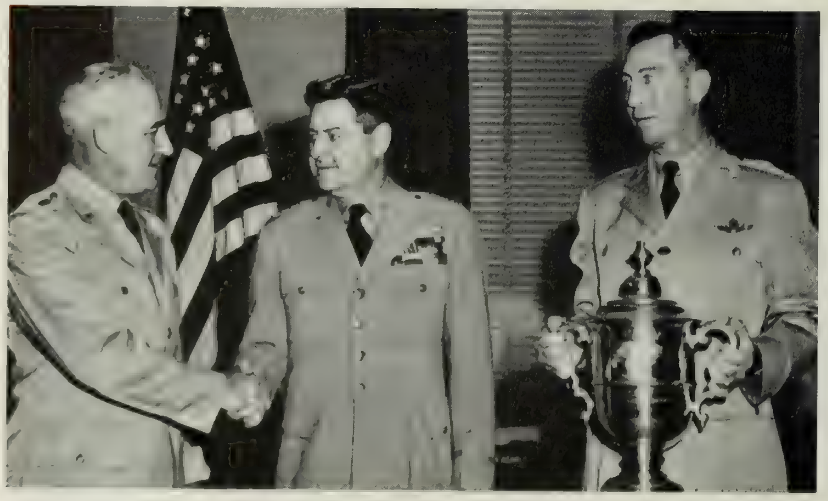
• **Cold Weather Demands Less RPM**—When taking off in cold temperatures, the pilot must control the RPM of the J-33 engine in order not to exceed its design limitations. At a given engine RPM the static thrust (designed for 4600 pounds) increases directly as the free air temperature decreases because the density of the air entering the compressor increases. In addition, fuel pressure increases under these conditions because more fuel is necessary to deliver the additional thrust.

Therefore, the pilot should adhere to the procedure of decreasing takeoff RPM as the free air temperature decreases. Of course, under emergency conditions, 100% RPM should be used.

The table below shows desired RPM for specific temperatures:

| Fahrenheit Temperatures | Desired RPM |
|---|---|
| Plus 60 | 100 |
| Plus 50 | 100 |
| Plus 40 | 99 |
| Plus 30 | 98 |
| Plus 20 | 97 |
| Plus 10 | 96 |
| 0 | 95 |
| Minus 10 | 94 |
| Minus 20 | 93 |
| Minus 30 | 92 |
| Minus 40 | 91 |
| Minus 50 | 90 |

Gen. Nathan F. Twining, Chief of Staff of the Air Force, presents the 1952 Daedalian Trophy for flying safety to Gen. Curtis E. LeMay, Commander of Strategic Air Command. The trophy, awarded annually, is held by Col. C. J. Cochrane, Chief of the Flying Safety Division, Strategic Air Command.



• **Cold Storage** — Due to limited facilities, some air fields are forced to store aircraft outside during cold weather. Pilots flying these aircraft must remember two important points:

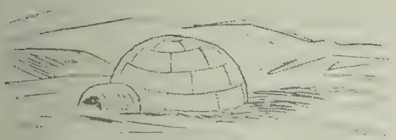
1. Any time there is moisture in the air at freezing temperatures, ice and frost accumulates on wing and tail surfaces, even if wing and tail covers are used. These surfaces must be cleared before takeoff.

2. Pilots should realize the possibility of windshield frosting or icing if a ground haze is present during takeoff. They then must be ready to go on instruments at any time during the takeoff run.

• **Where Did That Checkpoint Go?**—Traveling high and fast over snow-covered terrain in the Z. I. sometimes calls for astute jet pilotage techniques. When available, large check-points like mountain peaks in desolate areas are better to use. Of course, there are the usual "straight down" check-points such as towns, rivers, etc., when flying over populated areas.

Still, in winter many of these check-points have a way of camouflaging themselves and for the pilot tooling along in a jet there's no time to sit back and identify Punkinville village, which, according to the chart, should be just to the left of a river bend. Under these conditions one veteran jet pilot says: "Make a really careful check of radio equipment and of the radio facilities available along the first leg of your route, then rely on your radio and compass. Trust your instruments as you would in country where there are *no check-points*. It's only common sense not to take off under winter conditions without complete assurance that your radio equipment is O. K. for your flight."

# FROM THE SOUTH SEAS TO THE ARCTIC!



WHEREVER you fly — North, South, East or West — be sure you're up to date on your emergency procedures and survival knowledge. Know your own limitations as well as those of your aircraft and equipment and you can play it cool in the tropics and warm in the Far North. Make it a point to *always* plan your flight with Flying Safety in mind.

***Plan Ahead • Look Ahead • Keep Ahead***

☆ U. S. GOVERNMENT PRINTING OFFICE 1953—27113

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The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Form 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payment can be made for manuscripts submitted for publication in FLYING SAFETY magazine. Contributions are welcome as are comments and criticisms. Address all correspondence to the Editor, FLYING SAFETY magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Non-Air Force organizations must query the Editor before reprinting, indicating how the material will be used. The contents of this magazine are informational and should not be contrued as regulations, Technical Orders or directives unless so stated.

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# FLYING SAFETY

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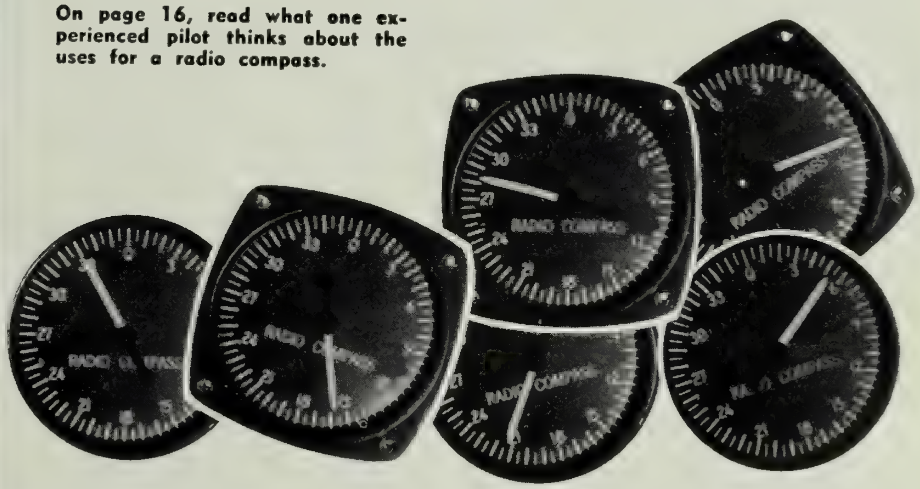
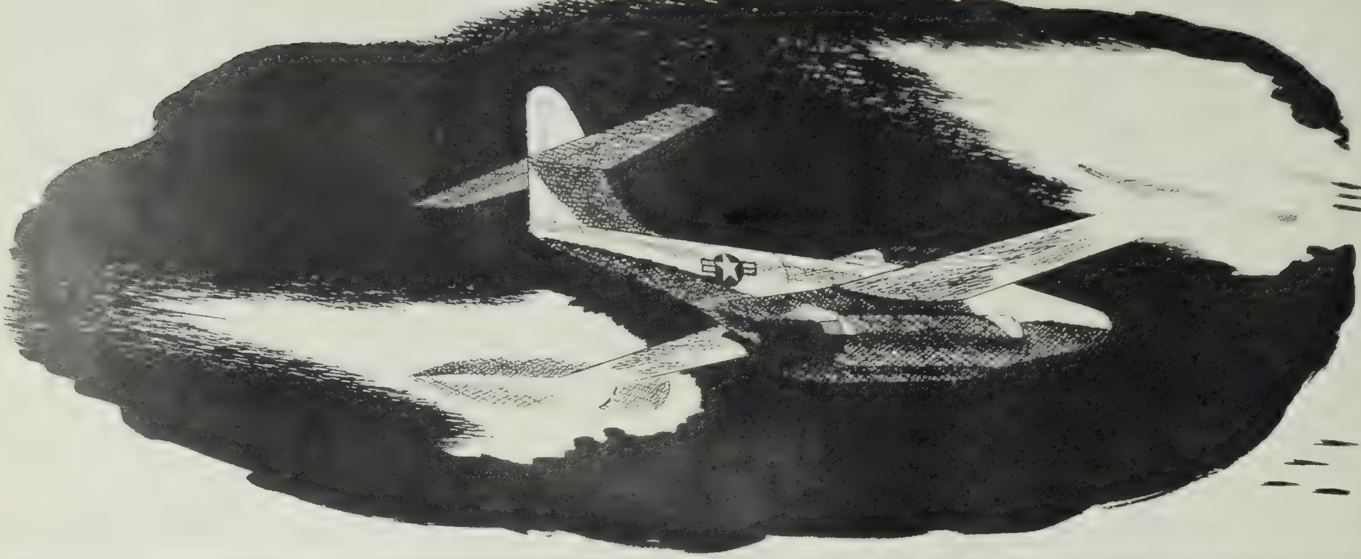
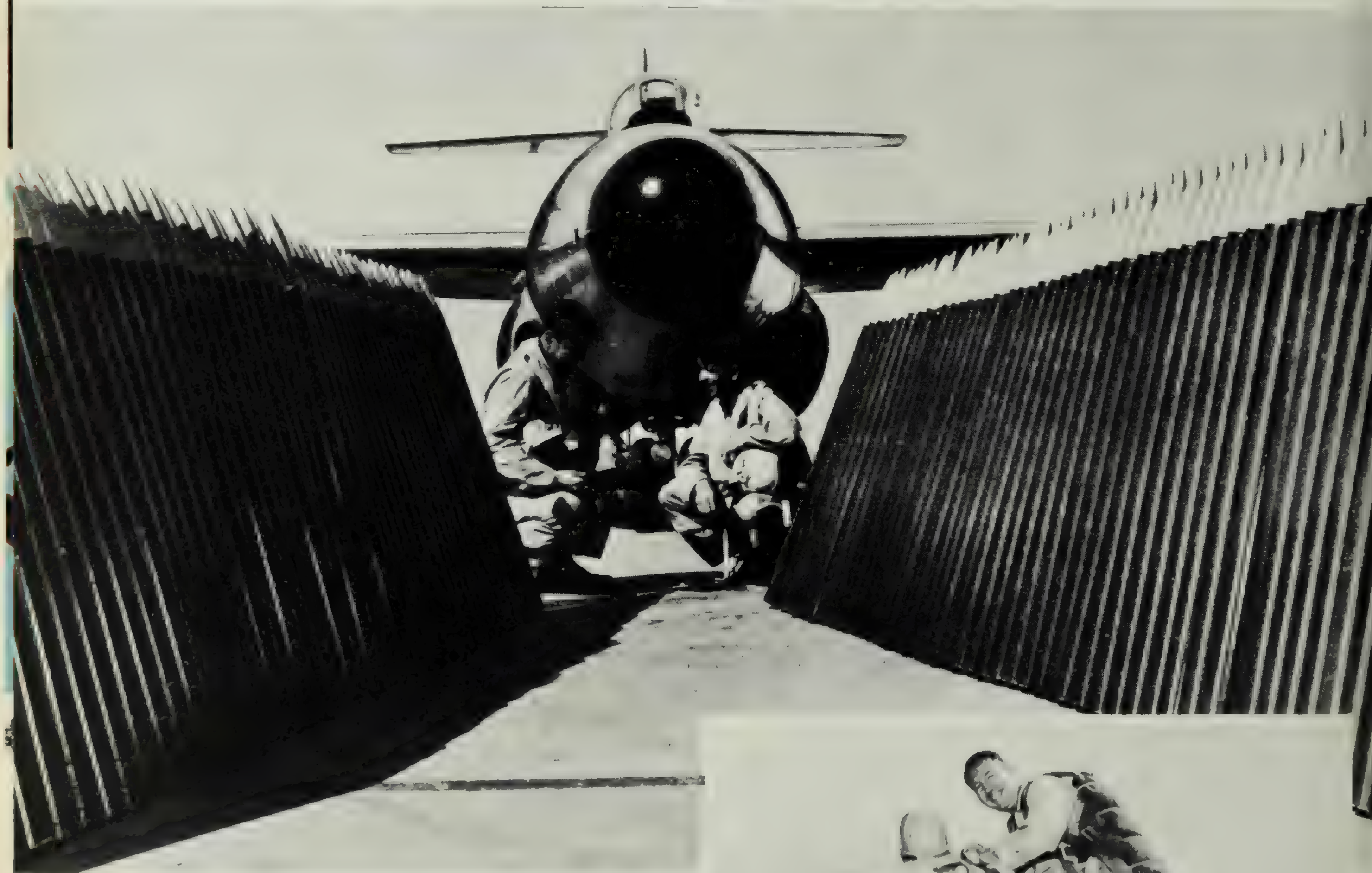
On page 16, read what one experienced pilot thinks about the uses for a radio compass.







This "picket fence" is formed by the 104 2.75-inch FFAR rockets that make up the F-89D's "Sunday Punch."

●

Engineering test pilot J. J. Quinn climbs aboard his aircraft for another mission in the F-89 test program which he conducted at Edwards AFB. Quinn was the first to fly the YF-89 and was at the controls of the first production model of the F-89A off the line.

# ...safety with a SUNDAY PUNCH!

## THE F-89D IS A BIG AIRCRAFT, EQUAL IN SIZE AND WEIGHT TO A WW II MEDIUM BOMBER, DESIGNED TO PERFORM ITS MISSION SAFELY.

**By J. J. Quinn, Engineering Test Pilot, Northrop Aircraft, Inc.**

THE tactical mission of all-weather interception means high speed and a fast rate of climb. It means the airplane must carry plenty of radar gear for locating and intercepting the enemy, a fire control system and armament capable of a single-pass knockdown and sufficient electronic equipment for communication and navigation on GCI, plus all-weather flying instrumentation.

The F-89D was designed for all of these. And, in addition, the designer provided two engines to increase all-weather dependability and give top performance while carrying this heavy load of electronic gear and armament.

### Many Features

Let's consider some of the other features of the F-89D. A profile view of the airplane discloses a high upswept tail assembly, which creates the characteristic "Scorpion" silhouette. The horizontal tail, located halfway up the vertical stabilizer is above the turbulence caused by airflow leaving the wing, thereby giving excellent control effectiveness. Our engineers feel the aerodynamics of the plane's straight wing and high tail combination offers the most desirable configuration for this interceptor. The wing is also more rigid than a sweptback wing, permitting armament to be carried on the wingtips. Armament stores, such as the heavy rocket load of the F-89D, are carried close to the C.G., eliminating great changes in pitch after firing. Moreover, the plane has no aileron reversal tendencies at high Mach, nor does it have any pitch-up tendencies due to elevator upfloat.

Official announcement that it is in the "600-mph-class" points up the F-89D's ability as a high speed aerial defender. It can locate and intercept hostile aircraft at altitudes in excess of 45,000 feet.

The F-89D is a big airplane, equal in size and weight to a medium bomber of World War II. It measures 57' 10" from wingtip to wingtip; is 53' 10" in length, and 17' 6" high and weighs over 40,000 pounds.

It carries a two-man crew; the radar observer seated tandem directly behind you becomes your "eyes" on an intercept mission. (Operational analysis by Northrop designers indicated the two-man operation essential for the combat effectiveness of the F-89D since optimum operation of radar to successfully perform the mission is a full time job.) Successful completion of the F-89 mission depends upon the ability of you and your R/O to think and act as a team, technically and psychologically.

In addition, the R/O is in effect your "insurance," your constant flight safety engineer. Not only does he operate the radar equipment, but also he mans numerous other communication devices in maintaining contact with ground stations and other friendly aircraft, and in operating radio navigation equipment. Further safety insurance is his constant contact with you through instruments and a voice intercommunication system. His cockpit instrument panel board enables him to double check your procedures through most phases of flight. The highly effective radar system is useful not only on intercept missions, but as an added safety factor since it can be used to monitor minimum weather landings when the field is weathered in.

### Heavily Armed

The Department of Defense has permitted disclosure that the F-89D is America's most heavily armed interceptor. It carries its 2.75 inch FFAR rocket armament in permanent wingtip launching pods. The wingtip pod location for the rocket launching platforms is a "natural" from combat and safety standpoints, and offers some advantages over conventional fuselage or underwing locations. It permits large numbers of rockets to be carried and secondly, and highly important from a flight safety standpoint, firing doesn't interfere with the crew vision at the critical moment of breakaway from rocket gases or debris being sucked into the engines or into the air conditioning system and cockpit. Design of the tip pods is such that a malfunctioning rocket will burn out without danger.

Earlier models of the F-89—the B's and C's now operational with fighter-interceptor squadrons of the Air Defense Command—carry six nose-mounted 20mm cannon.

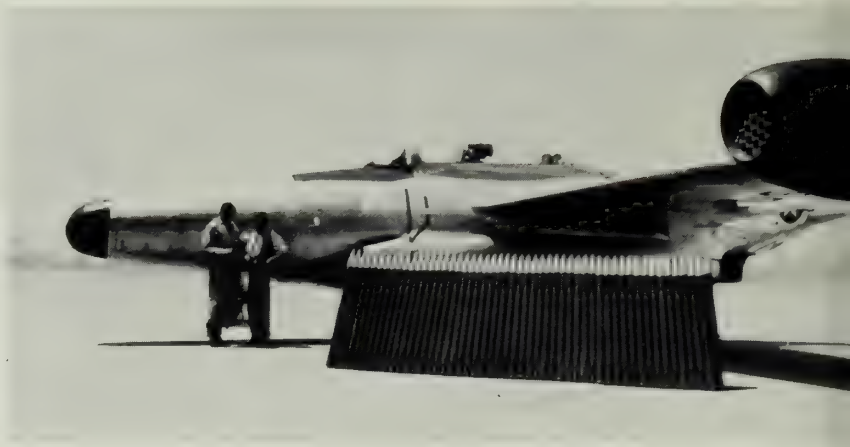
The F-89D is an easy airplane to fly, with remarkably "honest" handling characteristics. All flight controls are 100 per cent hydraulically powered. The full-time control system features irreversibility of control, an extreme advantage in high Mach airplanes because of the irregular loads imposed as compressibility shock moves back and forth over the control surfaces.

To enable the pilot adequately to determine the amount of control movement on the F-89D, "feel" is created simply and genuinely by springs attached to the stick and rudder pedal mechanisms. For the elevator, additional help is provided by a force-fuel system consisting of a force bellows and bobweight combination which produces "feel" in direct proportion to air speed and load factor.

Twin engine reliability of the 600-mph-class airplane is of vital importance to the crew while flying interception missions. Tests have proved that in event of an engine failure after takeoff or during the mission, the F-89 is capable of returning to its base on the one remaining engine. This reliability is particularly valuable as a safety factor on missions over mountainous terrain or over water. In addition, should the airplane lose both engines on a mission, it is provided with an emergency flight control system, tied in with the highly effective full power control system, which enables the pilot to operate the controls and make a "flameout" landing without powerplant function of any type. The F-89D is powered with Allison-built J35-series turbojets with thrust-augmenting afterburners.

The possibility of fire must be considered in any aircraft. In the F-89D, the fire extinguishing system has overheat detectors and fire detectors in each engine nacelle, and an extinguisher bottle in the nosewheel well with a discharge line to each engine. Overheat lights, fire warning lights, and controls for the extinguisher bottle are on a panel in the pilot's compartment. When either engine fire selector switch is moved to "emergency," fire wall shutoff of fuel is accomplished, and the electrical circuit for the fire extinguishing system is armed.

When the pilot closes the discharge switch, current flows to the selected discharge valve on the bottle, and the cartridge is fired, piercing a disc, and discharging the bottle contents into the manifolding of the engine. The agent vaporizes and dilutes the oxygen content of the air in the engine bay so that it will no longer support combustion, extinguishing the fire.



Pilot psychology was engineered into the pilot's compartment to make it an easier airplane to fly. Our engineers designed all cockpit controls so that they have a "natural reaction." Each control handle is contrived to have a motion in the same direction as the movement of the component it operates. Control knobs throughout the cockpit have also been designed into various different shapes so they can be readily identified by feel as well as visually, which is an advantage in all-weather and night operations.

### Deceleron Control

While you're in the cockpit, you'll notice a control located right alongside the throttle. This controls the "decelerons," which enables you to reduce flight speed rapidly and still retain full control of the ship. Decelerons are jawlike control surfaces at the outer end of the wing trailing edge, which perform double duties as ailerons and fighter brakes. In normal flight, the jaws are closed and the controls function as ordinary ailerons. In dives, they open full for braking effect.

This split-aileron type speed brake has no adverse effect on aileron control. In fact, a slight amount of speed brake opening increases aileron effectiveness at high Mach. Also, since the speed brakes are symmetrical and since they are located almost in line with the airplane CG, their use has a negligible effect on trim. They give excellent airspeed control without changes in power setting, permitting a high rate of closure in combat while leaving maximum power available for a fast breakaway.

This air speed control also allows ample power to be maintained during the landing pattern and final approach in case a go-around is necessary. The unique dive brakes are a most effective means of speed control and are useful in formation flying, in dive recovery, in fast letdown from altitude, in minimum radius turns and in reducing ground roll distance.

The F-89D has remarkably short takeoff and landing characteristics, considering its speed and size. I've taken off at Hawthorne using only about two-thirds of the 5000-foot runway. Landings are also possible in comparative distances. No auxiliary devices are required to shorten the landing roll to this remarkably short distance. Of particular value in reducing the landing roll are the decelerons or "dive brakes," just mentioned.

Let's for a moment consider we have come into the pattern for a landing. The gear is dropping. If we could crawl under the airplane and watch the gear coming down, we'd notice that the last part of the nose gear movement is aft, which means that it will always be locked into place. There is no chance that it will be only partly down, because the air loads will shove it into place. The dual nosewheel has been designed so that it gives you good control on landing. You get immediate and continued good response, with no tendency for "mushing." The design, on a co-rotating axle, makes the gear wheels pull against each other and offers an excedingly safe

**Left, the 20-ton F-89's configuration is designed to accommodate a large assortment of lethal armament.**

●

**Right, test pilot Quinn briefs Brig. Gen. C. D. Vincent, VC, WADF, on preflight inspection procedures.**

●

**Below, there is no substitute for safety. Utilizing the checklist from prestart to shutdown eliminates the possibility of overlooking any part of a procedure.**

installation that requires no shimmy dampers.

### Safety In Design

Safety of the pilot and R/O, as well as combat effectiveness, has been a primary design consideration in the F-89D. The crew compartment is big and roomy. This can be borne out when I explain I am six foot one and weigh 200 pounds, yet still find plenty of room for complete survival equipment without having to be "squeezed" into the pilot's compartment. The radar observer, similarly finds plenty of "elbow room" in the rear seat.

Naturally, like all modern military fighter airplanes, the F-89D has bailout provisions for crewmembers, using ejection seats. Normally, the canopy is jettisoned, then the crew-members arm their ejection seats and are exploded clear of the airplane.

Another safety feature of the F-89D is its anti-icing system. The thermal system ducts hot air from the engines to various surfaces to prevent or remove ice formations, and does not affect the clean lines of the airplane with external attachments such as boots or blankets oftentimes used on leading edges for anti-icing.

Northrop is now undergoing the final phases of an extensive modification program to increase the ruggedness and tactical usefulness of F-89 airplanes, in accordance with U.S. Air Force instructions. The modification, effective on all F-89's, includes a wing rework that greatly improves structural integrity and high speed, low altitude stability characteristics. New, stronger wing attach fittings have been installed and the center and outer wings were beefed up generally. Wing tiptank fins improve the stability of the airplane.

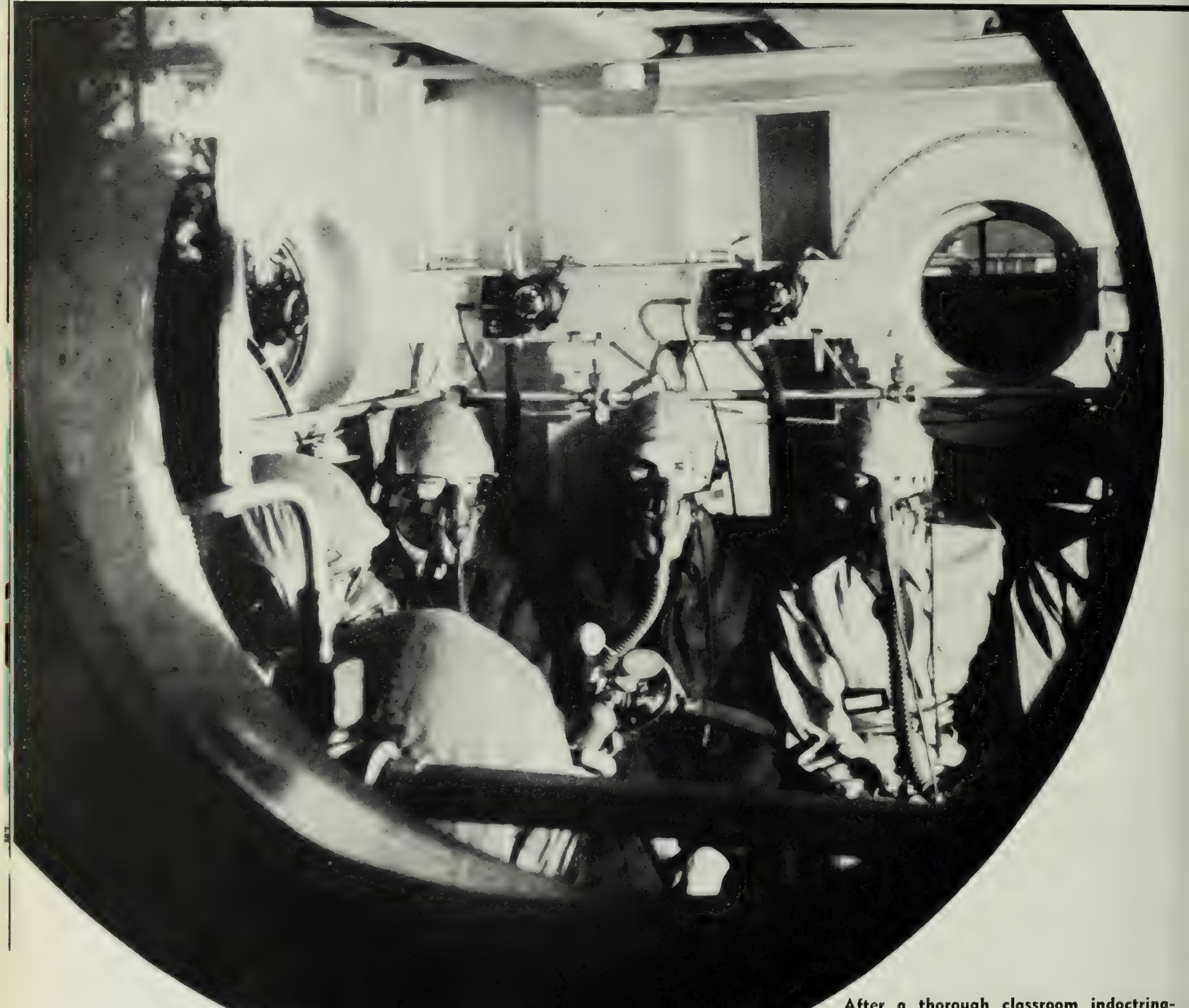
While there are several rules or precepts considered a "must" if you are to get the most out of flying an F-89D, one which I might mention here is:

*Fly cautiously in turbulence.*

Avoiding thunderstorms and severe turbulence makes sense. Of course, in combat, it may not be practicable. However, heavy turbulence, combined with high speeds and swift maneuvers can set up G's beyond design capabilities. It follows that airspeed and maneuvering should be reduced for turbulent air penetration.

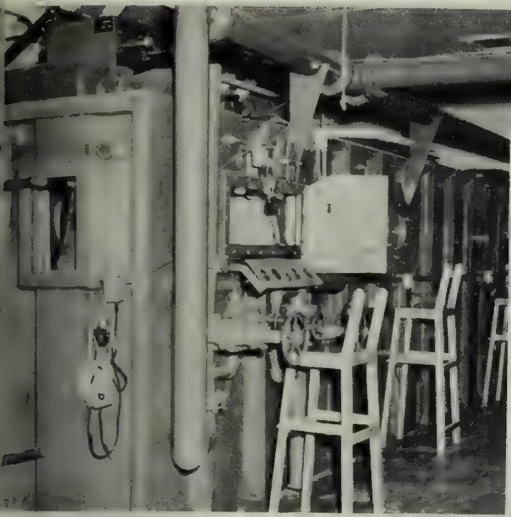
I live with all the precepts of safe flying of jet aircraft until they become second nature. But never to the point where I wilfully get careless or automatic in mind and motion. Sure, a lot of my manual and pedal actions are now reduced to reflexes but I try to keep mentally alert. It takes a little effort if you do. It costs like the devil if you don't. ●

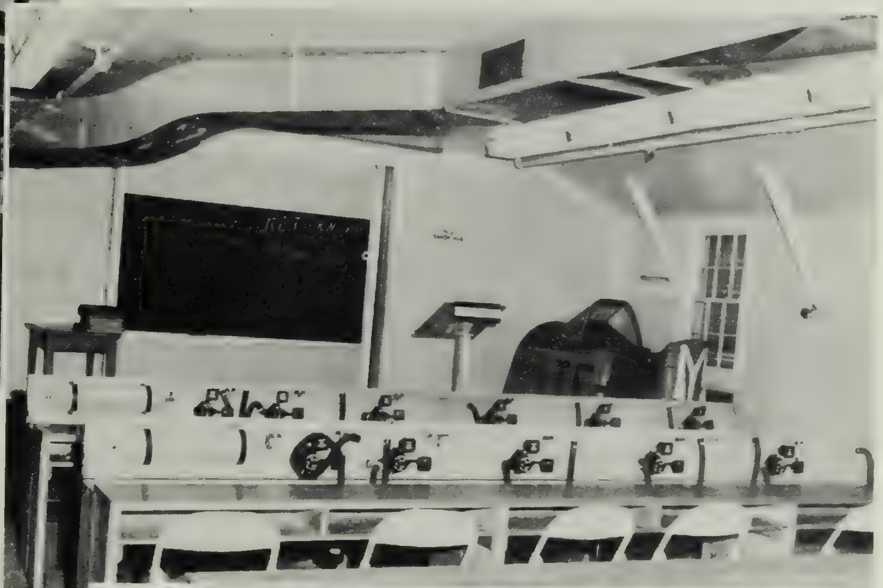
# UNDER PRESSURE

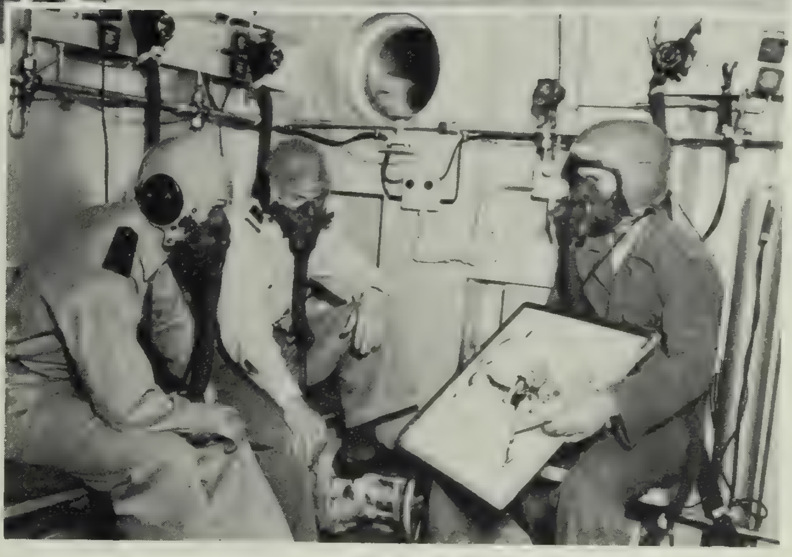


After a thorough classroom indoctrination, students make their first "flight" in the pressure chamber.

**Students at Craig AFB are taught the rules for safe flying at altitude. By experiencing hypoxia and observing hypoxic reaction they learn oxygen discipline.**







**Left, ascents and descents are regulated by the instructor on the inside through an intercom system. Center, students are taught every quirk of the oxygen system before entering the pressure chamber. Below, an instructor uses a diagram to explain what causes difficulty in clearing ears during a descent.**

THE class of 20 men filing into the altitude chamber was a study in contrasts. Most of them were aviation cadets, but there was a liberal sprinkling of officers . . . instructor pilots, and men from major commands on TDY for jet transition training. Ages varied, too. Here was a 20-year-old; behind him a greying Major. The new Air Force and the old were here, both vitally interested in the same problems.

The class had completed its classroom indoctrination. Sitting at specially-equipped desks, they had disassembled and reassembled equipment until they knew every quirk of the system. They knew how walk-around bottles worked; they had learned how to check mask hose-clamps, regulator connections and blinker indicators. Not the least important, they knew how to fit their masks correctly. These men knew aircraft oxygen systems inside and out. Now they were ready to go through the altitude chamber.

### Vital Training

This "tank" training is all important. Although each class is drilled in the physics of the atmosphere, and knows the reasons behind hypoxia, decompression sickness, explosive decompression and acceleration, few USAF pilots have very much time above 18,000 feet, especially on their own.

What does 18,000 feet mean in terms of physics? Well, the air pressure at 18,000 feet is only one-half an atmosphere; that at 27,452 feet is one-third of an atmosphere, and that at 45,500 feet is one-seventh of an atmosphere. This means that the higher your altitude, the less the oxygen pressure both in the atmospheric air and in your lungs.

For instance, you stand on the beach, dipping your toes in the water. At this sea-level pressure, you have 11 tons of air pressure on your body, distributed equally. Now you jump into your flying machine and climb to 18,000 feet. The 11 tons of air pressure have decreased to five and one-half tons, and this pressure decreases as you climb higher. This decrease in air pressure is what brings on the "bends," a condition that also bothers deep sea divers and tunnel men.

What causes "bends"? Without confusing you by stating Henry's Law, the bends is caused by the inability of the nitrogen dissolved in your tissue fluids and blood at ground level to stay in solution as the air pressure decreases. At reduced pressure altitudes, nitrogen bubbles form and produce a variety of symptoms, some of which may be extremely dangerous.

At 63.000 feet, unless the body is subjected to additional pressure, as furnished by the T-1 pressure suit, the blood actually boils and the pilot's skin swells.

After members of the class have entered the altitude chamber and signed the record sheet, they are seated comfortably in a circle around the qualified instructor who is always present in the chamber when tests are being run. Each student wears a cloth flying helmet, with earphones. The headsets and helmets are checked by the instructor, but the oxygen masks are not connected . . . yet.

The intercom is switched on, and the instructor tells the class that the first ascent will be made to 6000 feet. The pressure is then reduced to that present at the 6000-foot level.

The class next descends to 3000 feet at the rate of 1500 feet per minute. This is done to check the students' ears. If any student reports difficulty in "clearing his ears" the crew carefully increases the air pressure to that of ground level.

If no one reports a difficulty the class is taken to 18,000 feet, without oxygen, and asked to read a card. Then masks are donned immediately and oxygen taken by the student. With mask and oxygen he is asked to read the card again. This is part of a night vision test. The student can easily see how much greater is his vision at altitudes with oxygen. From 18,000 feet, with oxygen, the student is taken to 30,000 feet. During the "climb" it is made clear to every man in the chamber that if he feels any unusual symptoms or any pain, he should notify the instructor at once.

### Climb Completed

Now the long "climb" has been completed. The chamber levels off at 35,000 feet. The altimeter needles come to rest.

At this point the instructor calls for a volunteer to demonstrate the effects of hypoxia.

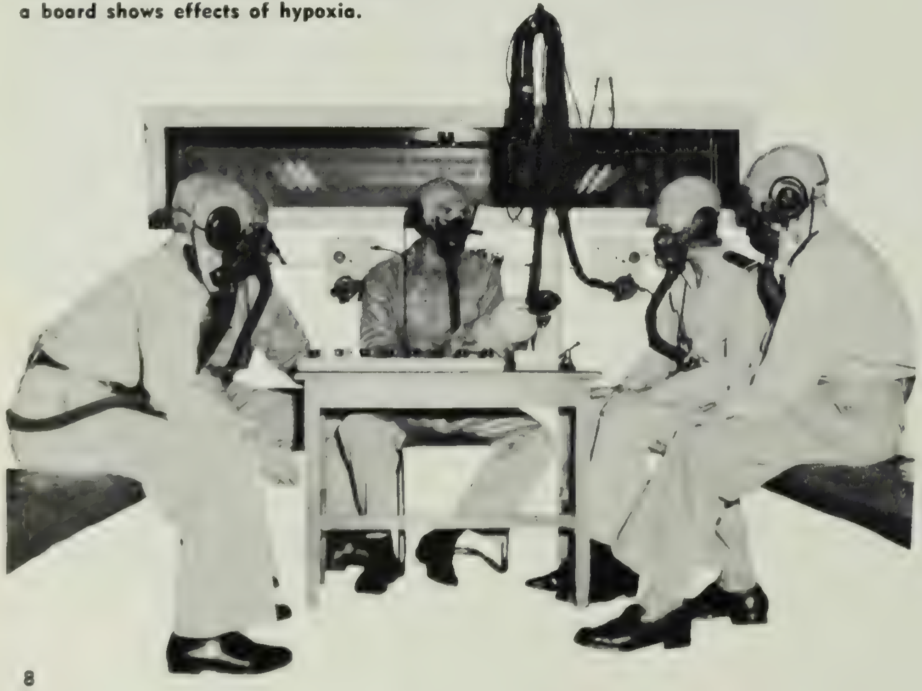
A brave soul raises his hand and the instructor removes the subject's mask, warning him that there may be a change in personality. The most introvert man may suddenly become a Milton Berle. The subject goes through hand coordination tests for nearly one minute, then his head drops on his chest. He's out cold! The oxygen mask is immediately replaced and the "guinea pig" comes around, with no ill effects.

After this demonstration, the chamber altitude is dropped back to 25,000 feet, and part of the class is given a new series of coordination tests.

Here at Craig, a wooden peg board is used. The pegs, with square shanks, can fit into the square holes in only one way. Each peg is painted half white and half black. Each subject is asked to pull a peg, turn it 180 degrees and place it back in the peg board.

With masks removed and the subjects experiencing a feeling of exhilaration, pegs are quickly changed—correctly at first. Within 30 seconds some of the men slow down and there is a general fumbling. At the 35-second interval, few of the subjects can fit the pegs. At 60 seconds, peaceful oblivion reigns over the subjects.

**At 25,000 feet the students will remove their masks and take a series of coordination tests. The inability to fit pegs in a board shows effects of hypoxia.**



The oxygen masks are replaced and the subjects revive. Once again there is no difficulty in turning the pegs, and most of the men won't believe they blacked out temporarily.

This peg-board demonstration proves the importance of oxygen discipline and training. Whereas a healthy man can hold his breath at sea level for a minute without being distressed, at 45,000 feet he will be out cold in 20 seconds.

This demonstration proves that hypoxia can creep up on you without warning.

After the demonstration the class is returned to ground pressure. As they step out of the chamber, the instructor checks each man for ear difficulty. Near the altitude chamber is a recovery room, completely equipped for an emergency.

The altitude chamber at Craig Air Force Base is under the direct supervision of Lt. Col. William S. Dandridge, M. C. Every safety precaution is taken, and the "tank" is checked regularly for any malfunction. There are two separate oxygen systems—one for routine use and one for emergency.

### Complete Training

Each flying student at Craig must go through the entire physiological training program, including the altitude chamber; IP's must take the course every two years. Men over forty years of age are carefully checked by the flight surgeon, and may be granted waivers to enter the chamber. As each student completes the course, his records are checked and notes of any difficulties are made.

The record of the indoctrination course at Craig is enviable. Some 250 students each month are processed through the Physiological Training Center, and over 4500 men have completed the course to date, without any serious difficulty.

The Physiological Training Unit at Craig has one and only one mission — to teach *Safety in Altitude Flying*. By experiencing hypoxia and observing the reactions of hypoxic individuals, the importance of oxygen discipline is indelibly stamped on the mind of each man. He learns what will happen to him unless he knows how his equipment works, how to use it, and the disastrous results of failure to use it *properly*. ●

**Jet shock waves are mighty disconcerting to the general public. They cause damage and create ill will for the U. S. Air Force.**

# Mind yer Manners!

THE PEACE OF SUBURBAN Los Angeles was rudely shattered one afternoon when a giant shock hit the city. Sounding like the crack of doom, it broke store windows and rattled bric-a-brac. Occupants of local bistros who had not seen daylight for months were brought out into the mid-day sun to gape skyward. Newspaper and police switchboards were swamped with incoming calls.

All because one sound-happy jet driver dived his machine through the sound barrier, too close to a populated area.

Newspapers made headlines of the story . . . and the publicity wasn't good . . . for aviation or for the Air Force.

During the past summer there have been at least twelve reports on sonic "boom" phenomena. And the worst part of it was that because of the altitude of the offending airplane, and the wide area affected by the shock wave, the culprit wasn't caught.

To the public it was just a "jet airplane." It could have been flown by one of the services or by a civilian test pilot. Because the public automatically thinks of jet aircraft in terms of the Air Force, thousands blamed it on the USAF.

Although there has been much comment on the part of reporters, aviation experts and just plain Monday morning quarterbacks, it is generally accepted that the shock wave phenomenon is caused by a jet aircraft passing through the sonic barrier in a straight dive.

As the airplane enters the barrier, it has the effect of compressing the air mass ahead of it into a hard cushion, or pillow of air. This mass attains high speed, building up pressure as it goes along, until it hits something solid . . . the ground, a housing settlement or a group of people. The result may be likened to the actuating of a pile driver. The great mass of air strikes with tremendous force and the noise is similar to a dynamite blast. There is a primary explosion and shock, with diminishing recurrent shocks following closely.

It was first believed that the shock wave was caused by a sharp pullout from the dive, after the airplane had passed compressibility, but experiments at Edwards AFB and by FEAF fighter pilots have proven otherwise. It's just a straight dive through the barrier.

To date, the "sonic boom" is generally believed to be a characteristic of F-86 aircraft and most reports have emanated from areas where F-86s are being operated by personnel of test centers and where practice intercepts have been made on Operational Readiness Inspection exercises. It is no secret that F-86s can enter the barrier more easily than can other operational fighters . . . to date.

The Air Force, however, is concerned about this phenomenon not only in the case of F-86s, but because new jet aircraft can skim through the barrier flat out . . . straight and level. And of course this would bode all kinds of trouble with the populace.

The solution to this situation is simple. The answer is air discipline controlled by strict supervision of pilots. Wherever possible, ORI intercepts should be planned for areas where houses are few and far between. In general, pilots should be warned, even directed, to abstain from diving aircraft over populated areas. It seems that when AFR 60-16 was hatched, no one ever dreamed that a pilot could buzz a community from 25,000 feet. But it has been done, as this story shows. Although a sonic buzz job is not strictly within the confines of regulations, a stop to this practice, intentional or otherwise, can be effected by close command supervision.

There is no excuse for bad manners, in the air or on the ground. As our grandmothers often told us, fighter pilots should be seen and not heard. ●

# Lead

**A properly lighted field must offer a pilot two things—visibility and familiarity.**

THE need for runway lights to delineate runways as an aid to air navigation was recognized many years ago. Many types of lights have been developed, and many lighting designs recommended. However, considerable uncertainty and a lack of standardization has existed within the many using and constructing agencies, both civilian and military.

Within these standards of configuration and colors, the strength of the lights and their physical characteristics must be reviewed every time new aircraft types are brought out, to insure that the facility provides the service required.

A properly lighted airfield must offer the pilot two things: visibility and familiarity.

First, the lights must be so designed as to give maximum visibility without glare; and, secondly, the pattern of the lights themselves must be so standardized as to lend familiarity to the pilot who is on final approach, or for that matter, circling for a letdown. This familiarity is important because it makes it unnecessary for the pilot to pause mentally and figure out which light is which and where his touchdown should be planned.

### Candlepower Problem

The problem of candlepower is the least difficult of the two. Isocandle curves can be accurately plotted and mathematical requirements set up, with a solid degree of tangibility. For instance, it can be hypothetically determined by plotting values that if strings of lights on both sides of a runway are to be seen from the 90-degree point in a 180-degree turn, a candlepower factor of 1000 will be required.

It can also be determined that adequate candlepower for taxi and touchdown functions is 200. Because operations and procedures are for all general purposes standardized, and are governed by regulations and aircraft characteristics, it is possible to determine the general direction and distance from any runway light to an airplane during the course of any specific operational procedure. The candlepower required to reach the pilot's eye without glare can then be determined mathematically.

Because airfield lighting standardization is a very recent development and still has not been jelled completely, it is believed that the problem should be discussed here for the benefit of the user, in this case the military pilot.

Remember that since the USAF operates on a world-wide basis, the addition of each new base in a foreign country and the development of each new airplane creates additional complexities of standardization.

From the viewpoint of accident prevention, the problem of approach lighting standardization is extremely important because the lack of standardization within using agencies can be and has been a flight hazard.

A typical instance, on record in the files of the Directorate of Flight Safety Research, states that a primary cause factor involving major damage to a B-29 airplane was the non-standard approach lighting configuration at a certain overseas base. The B-29 crew had received transition in night flying in the ZI, using a certain approach lighting pattern. After a long overwater flight, the pilot attempted a night landing at a strange field. He became confused on final approach by the unfamiliar lighting pattern and the result was an undershoot.

Had standardized approach lighting been installed, the overseas airfield would have looked as familiar at night as the pilot's home base. The anxiety factor would have been negligible, and the landing would have been made under conditioned reflex circumstances.

The largest obstacle to standardized approach lighting has been the variance of opinion between not only the military services but between the services and civil aviation users.

It is natural to assume that there could be a difference in lighting design between countries that have set up their own standards of military and civilian air operations. But lack of standardization within various

# KINDLY LIGHTS...

military agencies is apparent. The governing factor has been the variance in airfield regulations, particularly those governing the length of over-run and obstacles within the approach zone.

Primarily, approach lighting designers are divided into two camps: the "slope liners" and the "nonslope liners." These are the two basic approach lighting systems and discussion between the two camps often ends in a heated argument which benefits the engineers but leaves the pilot without standardized lighting systems.

The goal of the ideal approach lighting system is one that will give accurate information to the pilot as to line, position, altitude and progress under conditions that conceal the ground plane (plane of the landing surface).

Most approaches are now restricted to conditions where a degree of visibility exists under an overcast, and the plane of the runway surface can be seen during final letdown. Under these conditions almost any recognizable pattern of approach lights will furnish enough horizon reference to allow a successful approach.

But when the visibility is restricted close to the level of the runway by light fog, haze, rain or smoke, the condition changes drastically. It is practically impossible for a pilot to look at high intensity lights, after breaking contact, and then go back on the gages. He must use lights and lights only, after he sees them (i.e., change at once from IFR to VFR).

The slope line system has a great deal of merit but it has not been "bought" by the U. S. Air Force or the Air Line Pilots Association. Its big selling point is that a "distortion" pattern of lighting is formed, and by various distortions of configuration, the pilot knows when he is off course, right or left, high or low on glidepath. Sort of like a gigantic ILAS indicator laid out on the ground, in general effect.

The slope line pattern, however, does not conform to Air Force regulations prohibiting obstructions within the over-run area. The slope line units project 10 feet above the ground and are installed within the approach path where they intersect the ground at an angle of 45 degrees. Consequently, the innermost (closest to touchdown) fixtures cannot be more than 50 feet from centerline, and

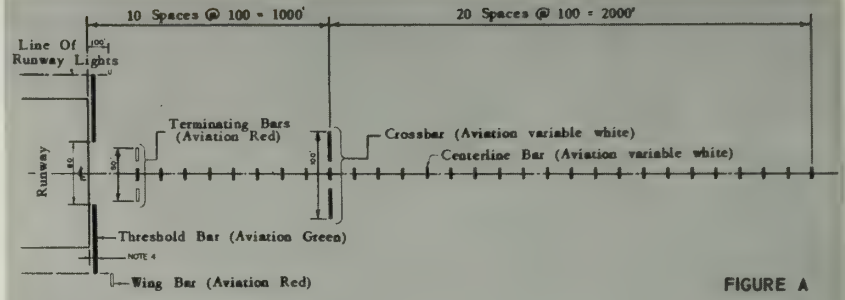

10 Spaces @ 100 = 1000'
20 Spaces @ 100 = 2000'
Line Of Runway Lights
100'
Runway
80
50'
100'
Terminating Bars (Aviation Red)
Crossbar (Aviation variable white)
Centerline Bar (Aviation variable white)
Threshold Bar (Aviation Green)
NOTE 4
Wing Bar (Aviation Red)

FIGURE A

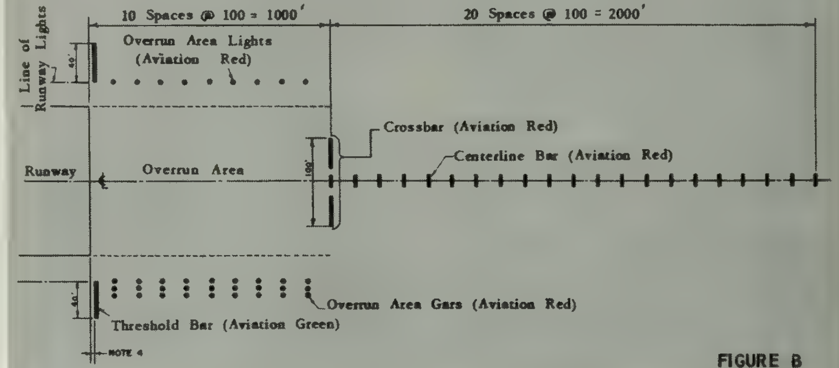

10 Spaces @ 100 = 1000'
20 Spaces @ 100 = 2000'
Line of Runway Lights
40'
Overrun Area Lights (Aviation Red)
Crossbar (Aviation Red)
Centerline Bar (Aviation Red)
Runway
Overrun Area
100'
40'
Overrun Area Gars (Aviation Red)
Threshold Bar (Aviation Green)
NOTE 4

FIGURE B

therefore they encroach on the overrun area. By the nature of their construction, the lights cannot be fitted with "break-away" standards, as are standard high intensity fixtures.

The slope line system is inflexible and is designed for a standard angle of letdown and line of approach. An additional weakness is that the slope-line glidepath and the touchdown point must coincide with the electronic glidepath and touchdown point. Once slope line is installed, it is fixed. It costs about $30,000 to change either the glidepath or the touchdown point if the slope line system is being used.

The nonslope line school argues that the most efficient and therefore the safest approach lighting system is that which conforms to the runway plane.

Although "flush lighting" is technically a misnomer, it fits the layman's description in that the lighting fixtures are "flush," or almost flush, with the level of the approach zone and runway. The fixtures themselves are usually standard high intensity lighting fixtures, equipped with red lenses, to distinguish them from the runway lights proper.

The lights are positioned at the edges of the over-run which is in effect a graded extension of the runway plane (although not necessarily load bearing).

### Safety Factor

The lights are equipped with breakaway standards which are easily and inexpensively replaced, should an aircraft swerve into them. The breakaway load is about *two pounds* shear force, which reduces damage to airplane tires and landing gears. The lights are low enough to clear control surfaces and tailcones.

In July 1953, the Subcommittee on Aerodromes, Air Routes and Ground Aids, of the Air Coordinating Committee, charged with preparing a national standard on approach lighting, informally coordinated suggested approach light standardization.

This proposed national standard presents a basic configuration consisting of a centerline, crossbar and threshold bars as shown in the illustrations. This basic pattern permits three possible system developments to satisfy various operational requirements.

Chart "A" (illustrated) conforms to the preferred system recommended by the subcommittee. In addition to the basic layout consisting of centerline, crossbar and threshold bars, it provides for a warning to the pilot that he is coming up on the threshold (landing end of the runway). This is done by the use of short terminating bars and wing bars located in the first 200 feet of the system. It also permits installation of sequenced flashing lights at locations where there is a need for a high degree of identification. System "A" (see illustration) is planned for locations having instrument runways, where no special operational requirements exist.

System "B" (illustrated) is designed as an acceptable alternate to System "A" for runways with overruns. This system also retains the basic layout consisting of centerline, crossbar and threshold bars, but omits the row of centerline lights in the over-run itself in order to keep this area clear of obstructions in the approach path. This plan is in consonance with AFR 86-1 and AFR 86-5, a factor that has always entered into any USAF discussion of approach lighting standardization.

Instead of the centerline lighting, two lines of lights are placed (one on either side of the over-run centerline) to cover the section of the approach from which the centerline lights are omitted.

To avoid confusion, a distinction is made by specifying that each bar along the left hand side of the overrun area appears as three distinct lights. The line of lights along the right-hand side of the over-run appears as a single line of lights.

System "C" (illustrated) is intended to provide a high degree of flexibility without destroying the basic elements of the standard system. This system is primarily intended to provide the basis of an approach lighting system for civil agencies, that satisfy the needs of any particular airport. This system has the basic plan of centerline, crossbar and threshold bars, but introduces additional elements of guidance along each side of the center row of lights. System "C" was also designed to be installed at locations where the predominant flight operation will be by aircraft having poor forward cockpit visibility that requires maximum sideview guidance.

### Length Question

A moot point, and one that has been discussed at length in standardization meetings, is that of the length of approach lighting. The USAF has always maintained that approach lighting contained within the normal 1000-foot over-run was adequate and safe.

The subcommitte, in order to coordinate with USAF thinking, qualified the paragraph on system lengths by recommending that approach lighting lines of less than 3000 feet may be installed where special requirement of the military exists, or where terrain conditions prohibit the installation of a full length system. The subcommittee says, however, under no circumstances should the light line be less than 1500 feet in length. This gives the pilot a longer period within the approach light gauntlet and allows him a few more seconds to get oriented. It does not in any way change the length of the overrun itself, which has been established as 1000 feet. In view of steadily increasing approach speeds of USAF aircraft, it seems that the 1500-foot line of lights is an increased safety factor for night landings or limited visibility approaches, provided of course that funding is approved.

The greatest problems facing approach lighting design are introduced by the visibility restrictions imposed by the structure of the aircraft and by variations in approach speeds. No approach lights are of any value unless the pilot can see them clearly, and in reference to the runway. It is possible to combat obscuration by selecting adequate intensities, and by introducing enough of the pattern within the limiting distance. Restricted cockpit visibility can block out lights and patterns normally visible.

The problems introduced by high speed approaches present even greater difficulties. Approach lights cannot be made effective under obscured conditions to a pilot who is 200 feet above the line of lights. This restricts the effective length of an extended approach light line to about 3000 feet at a glide angle of two and a half to three and a half degrees. The pilot can see this length of light line for about 16 seconds at 120 mph.

If the pilot's approach speed is above 150 knots, with restricted visibility, it is doubtful if the pilot will derive anything but limited benefit from approach lights. So until electronic landing devices have been perfected, the alternative is to accept restrictions which limit landing operations to weather conditions that allow the pilot to break contact soon enough to orient himself by existing approach lighting systems.

Design of an ultimately effective approach lighting system under all weather conditions remains a challenge to those concerned with the problem. In the meantime, any approach lighting system that is effective, safe and standardized is a good system if it gains its end purpose . . . that of lining up the aircraft with the runway and indicating the boundaries of the safe landing surfaces. ●

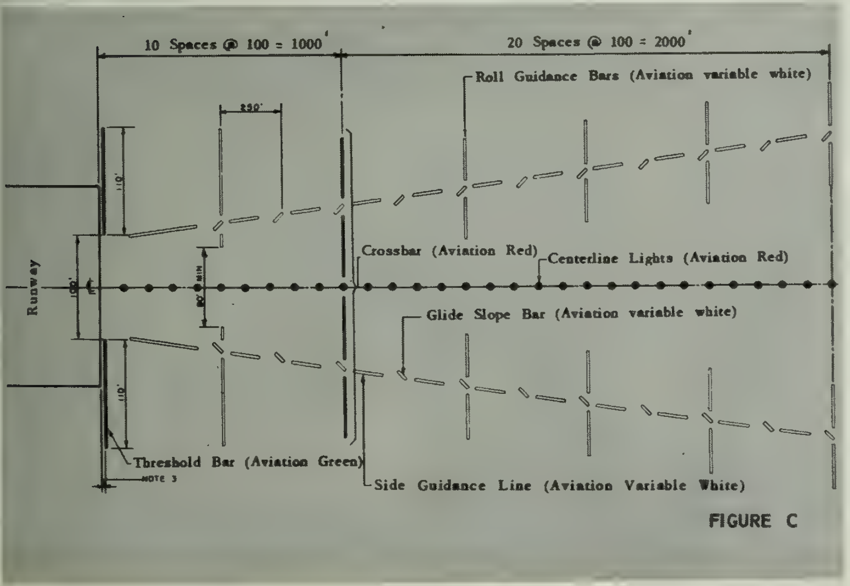

10 Spaces @ 100 = 1000'
20 Spaces @ 100 = 2000'
Roll Guidance Bars (Aviation variable white)
250'
110'
100'
80' MIN
Runway
Crossbar (Aviation Red)
Centerline Lights (Aviation Red)
Glide Slope Bar (Aviation variable white)
110'
Threshold Bar (Aviation Green)
NOTE 3
Side Guidance Line (Aviation Variable White)

FIGURE C

# Getting The Most From Your UHF

BACK in January of this year, we briefed an accident under the heading of "UHF Panic." Possibly, a few of our readers will recall that lack of equipment and some rather senseless assumptions led to the destruction of two T-28s. Today, we are still in the midst of UHF growing pains and the thought occurs that a review of existing facilities may well be in order.

First, most of us agree that UHF is a sound step toward good communications. True, there have been many bugs to iron out, and we still have a long way to go to reach the projected goal. We do feel, however, that if you, as a pilot, will give a bit more thought to UHF flight planning, the old accident potential will be whittled down even more.

### Musts for Pilots

What are the musts for a pilot contemplating an extended flight in a UHF-equipped aircraft? Let's sum them up:

First, common sense. This must be followed by a knowledge of the limitations of Ultra High Frequency equipment, a sincere interest in NOTAMs, and a thorough understanding of the latest Radio Facility Chart for the area to be flown. Couple these four prime requisites and you have the basis for intelligent flight planning.

### Common Sense

We place common sense at the top of the list for this is a most necessary attribute to insure proper correlation of all other information available to the pilot. You can have all of the information in the world at your fingertips, but without proper application, it becomes useless.

Unfortunately, too many pilots have expected to find a time tested and operationally proved piece of equipment when first exposed to UHF. In most instances these individuals have suddenly been faced with the realization that this was not so and have taken positive action to preclude any possible accidents.

In order that UHF-equipped aircraft coming off the production lines would have suitable ground contacts, an interim UHF program was established using borrowed Navy equipment as well as some modified airborne radios. None of this early gear worked too well and was, in many instances, an accident producing potential. The picture today is changing somewhat for the better as permanent ground equipment is being produced and installed as rapidly as possible. This in turn means that the supply and maintenance headache

The ADC and CAA have worked out an experimental proposal to provide radar advisory service to aircraft in the Minneapolis, Kansas City, Albuquerque, Chicago and St. Louis Air Route Traffic Control areas.

The basis of the proposal is this:

Upon the request of a pilot, through Air Route Traffic Control channels, Air Defense radar stations will provide advisory information on detected severe weather areas and the safest flight path through these areas.

It is understood by all concerned that this service is not to interfere with the primary mission of the ADC or the traffic control of the CAA. Procedures for using this service will be published in Radio Facility Charts.

**The UHF picture today is rapidly changing for aircraft of the USAF. Right, page 5 of the facility charts gives pilots the latest on interim channelization program.**

is rapidly disappearing.

### Study the Charts

The Radio Facility Charts certainly need no introduction. Except for the most recent changes, which will be found in the NOTAM files, these charts will give you a pretty fair picture of the UHF program. A bit of time spent studying the Radio Facility Chart is never amiss for any of us. Page 5 gives you a picture on the Interim Channelization program and should be consulted when planning a flight with UHF-equipped aircraft.

You will note that the majority of CAA Airways Stations (ranges) that are equipped with UHF are currently set up to *receive only* on Ultra High Frequency. This means that if you expect to establish two-way communication, and you have UHF command equipment, it will be necessary to tune in your radio compass on range frequency, and stand by to receive with the compass.

As we noted, page 5 of the Radio Facility Chart lists current channelization, but here's one joker in the deck. Because of the rapid changes that are taking place in the UHF picture, we find that in some instances the frequencies assigned to both military and civilian facilities do not always correspond to the frequency listings. Keep that in mind when flight planning and *always* refer to the Special Notices section in the Facility Chart before leaping off in a cloud of kerosene smoke.

Another point to bear in mind right now is the actual scarcity of UHF military emergency frequencies. Best you screen that little angle carefully before embarking on any form of extended cross-country. If you'll examine a current copy of the Facility Chart, you'll find a grand total of seven stations equipped with UHF/DF equipment throughout the entire country. Three of these are operated by the Navy. That's a good thing to remember.

Here's something else that is certainly worth checking carefully: You'll find, in studying the section devoted to Radar, that four USAF Ground Controlled Approach units do not have UHF frequencies while conversely only four civilian controlled GCA units are so equipped. We suggest that you remember this current situation when planning your flight. It could prove rather uncomfortable under some conditions to find yourself fresh out of GCA assistance just about the time the totalizer has given up the ghost.

### Advantages

One of the projected advantages of UHF communications throughout the Air Force centers around instantaneous contact between airborne pilots and our forecaster service. When this program is finally a going concern, the advantages will be tremendous. However, at the present time, this service is extremely limited, with only three or four such Air Force stations offering this aid.

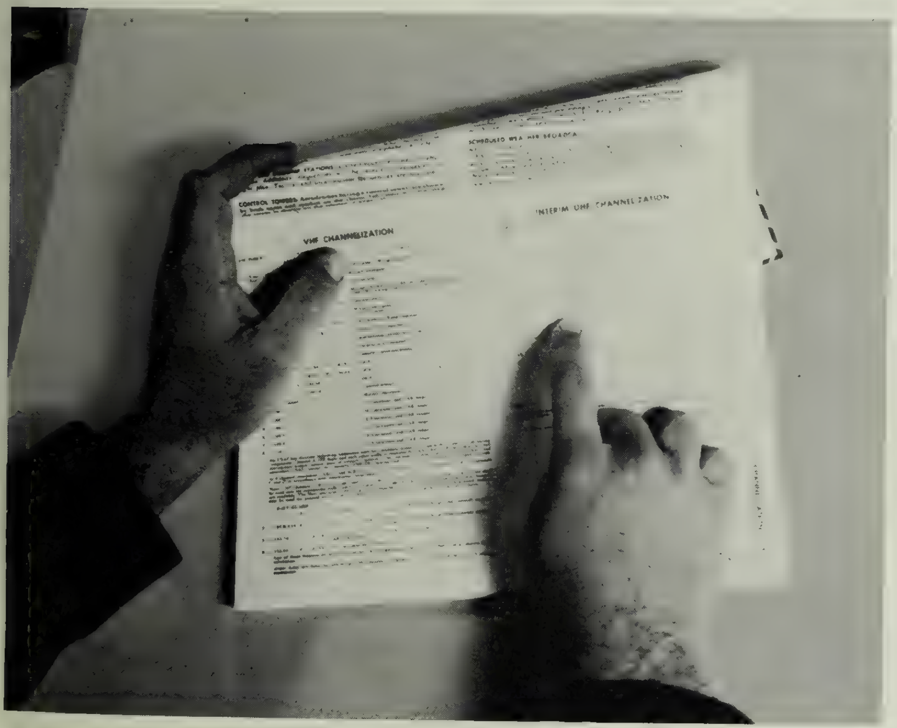
We've all had the necessity for studying NOTAMs drummed into our skulls for years. Of course there's always the rugged individual who proclaims that such stuff ain't for him, but as a rule he winds up on our statistical charts, and we'd honestly prefer to let those charts remain static as long as possible. If you are going to be tooling around in an airplane that is equipped with only the UHF command equipment, then by all means be doubly aware of the necessity for the NOTAM check.

The UHF ground program is in a constant state of change. In order to provide improved service and implement permanent ground facilities, changes are being made almost daily. With that in mind, you can see that it is impossible to maintain Radio Facility Charts in a state of completeness that is desirable. The only other answer then must lie with our NOTAMs. It is the only means of disseminating current information relative to facilities available for a projected flight.

Another very important *must* centers around your UHF radio equipment itself. We do not imply that it's any more critical than the old command set or the 522 or what have you, but it certainly must be checked carefully prior to takeoff. Make sure that your UHF is putting out a solid signal and receiving a like signal in return. By the same token, do not neglect your radio compass equipment. After all, it's virtually your only means of navigation and has to double in brass as your receiver for CAA traffic instructions from those numerous range stations that have UHF receiving facilities only.

Well, that's about it. Plan your flight carefully. Determine *in advance* the stations and frequencies that will enter into the problem. Give the latest Radio Facility Chart a good work out. Study the NOTAM file and *know* where you stand.

And last, but not least, insure that your airborne radio equipment is working properly before leaping off.●



# A PILOT'S BEST FRIEND IS HIS Aural Null

By Colonel Vincent J. Donohue, Headquarters, Kelly AFB

EVER been in heavy rain, dust, snow or ice crystals while actually on the clocks? The reception on your low frequency Command Receiver was bad or non-existant. Well, what did you do when you found your Command Receiver was going to be little or no help?

Chances are you used radio compass, selector on automatic. Took you to your destination like a homesick homing pigeon. Possibly you first tried putting the radio compass selector on antenna position. But that was too noisy. Not much better than the command receiver. Maybe then you wing tipped your loop and found the range course was too broad. Maybe you're not too sure what the score is when using the loop on manual, anyway. But then, you say, why worry so long as that radio compass on automatic takes you home.

### Thunderstorm Finder

Well, there is a shortcoming to that procedure that you may discover some day, to your sorrow. In flying in or around thunderstorms, the automatic *direction* finding feature of your radio compass usually becomes an automatic *thunderstorm* finder. In mountainous regions where lodestone deposits are present, it is just as likely to become an automatic *lodestone* finder, too. When you're IFR, that's not good. So in some respects, the radio compass isn't all it's cracked up to be. But, and this is good news, in one way it is virtually unbeatable. Listen, now to the ungarbled word on how to use your loop.

There is an old adage about all roads leading to Rome. This saying can be parodied to apply to your radio compass with the selection on loop. It will then read, "All roads lead to Home." By roads here I mean the many ways of utilizing your *aural null* to get you safely home.

The first and most elementary of these of course, simply involves tracking inbound so that your path over the ground approximates the published magnetic course to the next radio fix. For example, flying standard four-course ranges in the mountains or along a coastline, occasionally even over flat terrain along toward evening, you can normally expect the particular leg you're riding to drift from side to side.

When you are at minimum altitude in the hill country, or trying to fly a nice straight course on instruments in a coastal defense zone, or in a number of other analogous situations, this inconsiderate swinging of the range leg can become disconcerting, if not hazardous. But what to do about it? You read my mind, amigo. Use your aural null.

### Tune Carefully

Naturally, first a caution. Always tune your station in carefully with your selector on antenna. Once you have *positively* identified the transmitting station, the following steps will get you to your next check point, or your destination, without strain: (Chart # 1.)

- Place selector on Loop.
- Flip the CW-Voice switch to CW.
- Rotate the Loop until the needle points to 0° (360°) on the azimuth in the cockpit.
- Adjust the volume so that you get a good clear null, approximately five degrees wide, turning your air-

plane if necessary to get the null centered on the nose.

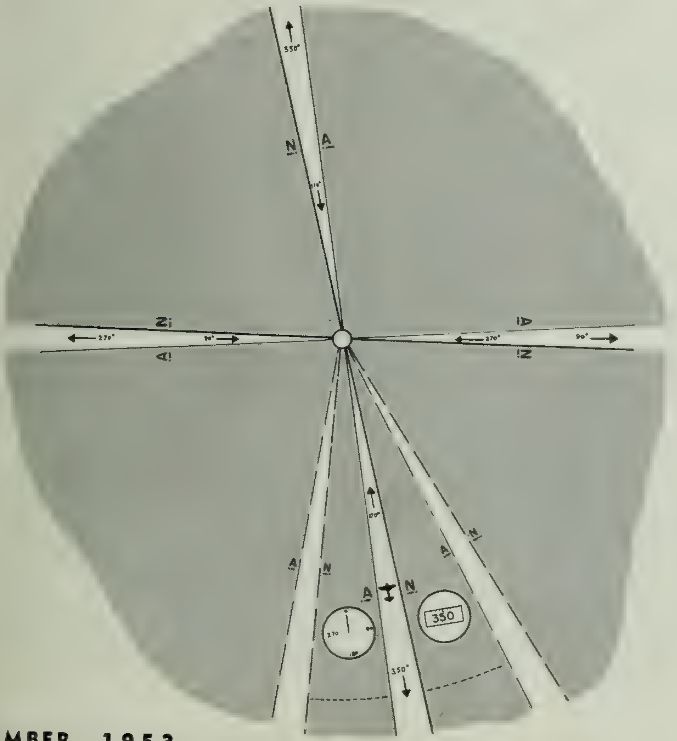
- Check the heading of your compass against the published range course of the station ahead and you will quickly learn whether you are to the right or left of track.
- Track in to the station, using your aural null and directional gyro to keep you on or to get you on a published course. Remember that it will be necessary for you to keep turning the volume control down as you approach the station in order to retain your five-degree null, the optimal width.
- Over the transmitter you will lose your null and your reception will be louder than at any time in the entire procedure. This broad signal is known as an "inverted cone," as opposed to the cone of silence you would normally get with your loop on the wingtip position.
- Positive checks on station passage, in addition to high signal volume, followed by rapid widening of the null once past the station, are marker beacon indications and a maximum reading on the tuning meter of the radio compass as you fly over the transmitter.

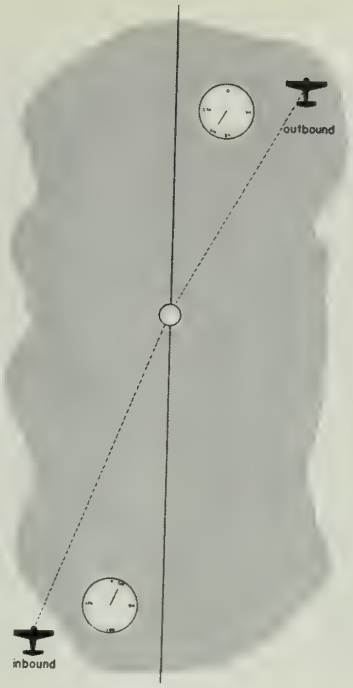
A second way to get your aural null to pay off is to use it to "spiral" down a cone. (Chart # 3.)

This procedure can be used to insure letting down safely into narrow valleys and landing fields in mountainous areas. The following constitute the simple steps involved:

- En route, while at cruising altitude, work a wingtip null procedure to get a time/distance check from the station.
- Verify your time estimate against actual station passage as a double check.
- Fly beyond the station for two minutes, one if operating in a "cylinder," then turn either right or left until you pick up a wingtip null. (For the sake of illustration, assume you turned clockwise to get your wingtip null.)
- Now maintaining a constant airspeed, adjust the loop and aircraft heading so that you get your null when the needle points to 80° on the azimuth.
- When you get a null on 80° on the azimuth, stop the turn and continue on that same course.
- Holding course, promptly adjust loop so that the indicator points to 100° on the azimuth.
- When you get a null with the indicator on 100° while holding constant course, set loop indicator to read 80°, and turn right until you again get a null on 80°.
- Hold this course while null moves back to 100°.
- When you again get a null on 100°, repeat steps 7 and 8.

**Using Aural Null in range flying when courses are swinging or multiples present. (Chart I)**





**(Chart II)**

**When paralleling desired course, your null (needle) is always directional, i.e., always indicates (left-right) the direction in which you must turn to get to your track.**

This procedure keeps you at a constant distance from the station and enables you to spiral down the cone at any rate of descent desired, or you can use it for holding indefinitely. If you are descending, you can usually break your turn off to correspond to the heading of the landing runway adjacent to the transmitter, or to the reciprocal heading of that runway.

### Feature Null

A third way of putting your aural null to good use is to feature it instead of the automatic direction finder to work a standard range letdown on published headings. Again reliability of the aural null makes this procedure safer than using your radio compass with the selector on automatic. The steps involved here are:

- Set up nose null as before.
- Track in to the station on published course.
- Check for station passage.
- Track outbound after passing station.
- On a three-minute flyout, before completing your procedure turn you should hold the heading of the initial portion of the turn until the 45° difference between the 180° calibration on the azimuth and the position of the aural null as indicated by the needle has decreased approximately

**"On Automatic position, the radio compass may home in on a thunderstorm."**

30°, i.e., in a right turn the needle and null will have changed position from 135° to about 150°, while in a left procedure turn the null will have moved back from 225° to approximately 210°. This gives you approximately a one-minute procedure turn. For varying flying times, adjust your timing during holding of initial portion of procedure turn by reducing it approximately 15 seconds for every minute less than three minutes of flyout time from the station. (Chart # 4.)

- After completing the procedure turn and while heading back to intercept the inbound course, adjust loop to 85° or 265° position of indicator on azimuth, depending on direction of procedure turn just completed. (Chart # 4.)
- When a wingtip null is obtained, either on the 265° or 85° position of the azimuth, turn to published inbound course and proceed to track to station. When you get proficient in the use of the aural null you can use it to "follow" the station all the way through the procedure and check your position against it at any time.
- Use methods given in preceding cases to identify station passage.

And yet, another method of using the aural null is worthy of mention here. Virtually every intrepid birdman and his brother is familiar with the method of using the null on the wingtip for time/distance checking purposes.

Few pilots, however, are conversant with the fact that it is not necessary for the station to be exactly off the wingtip before such determination of time or distance from the station can be undertaken. All that is necessary is that you tune in a radio station on either side of your course. This method cannot be used successfully if station is directly ahead or behind aircraft. Your steps are as follows: (Chart # 5.)

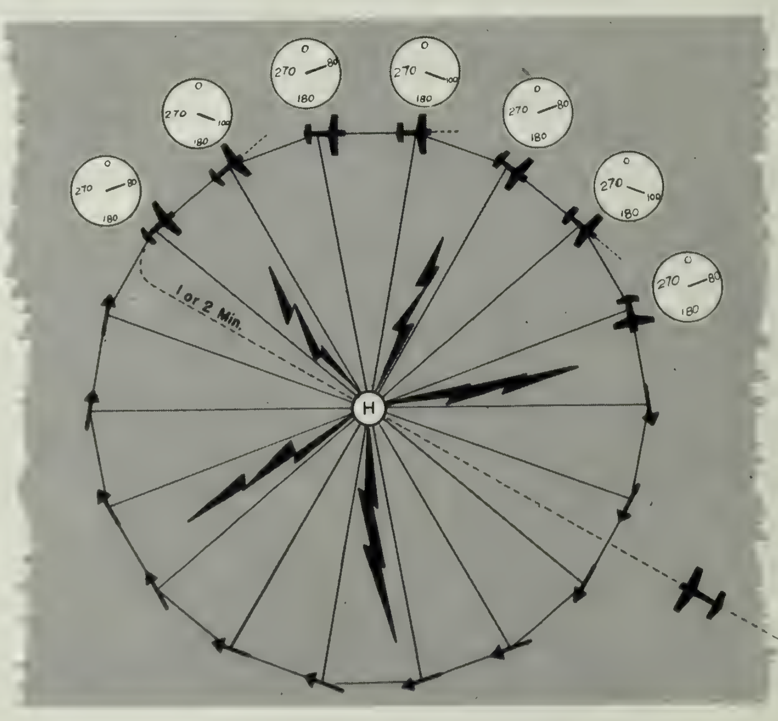
- Once station has been positively identified, get a null on it.
- Note the number of degrees between the position of your null, as indicated by the needle on the azimuth, and the zero calibration on the azimuth scale itself. Note the time on your clock at this point.
- Hold a constant course and maintain your airspeed for the length of time it takes your null to move to a position, as indicated by the needle, where the number of degrees btween its original position and the zero calibration on the azimuth has doubled.
- The time taken for your null to double its distance (in terms of degrees of relative bearing) from the zero calibration of the azimuth is the time it will take you to fly to the station you are tuned to.

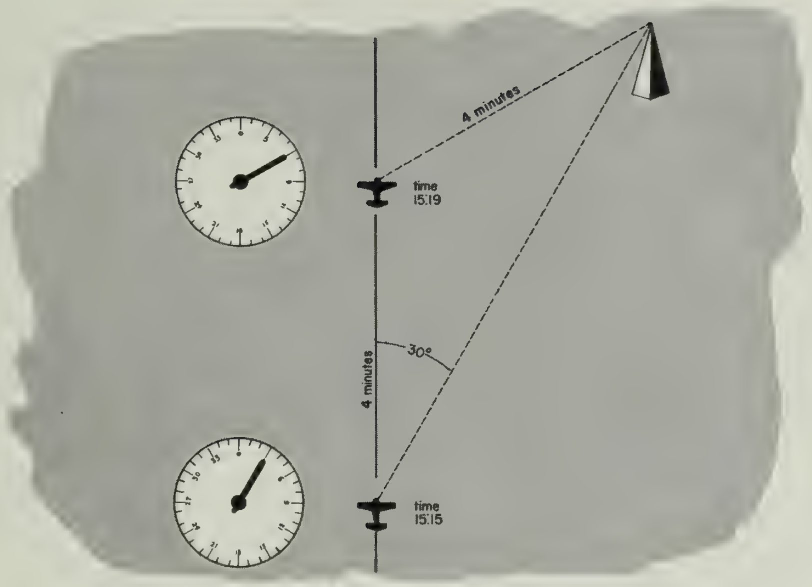
Distance to the ground can be obtained by multiplying your ground speed, in miles per minute, by the number of minutes you have ascertained it will take you to fly there from your present position.

### Versatile Aid

All of the foregoing reference ways and means of using your aural null, which were described here in part to show you what a versatile and reliable radio aid you have when your radio compass selector switch is on loop

**Use of Aural Null in holding at a constant distance from a station or in spiral descent around station. (Chart III)**





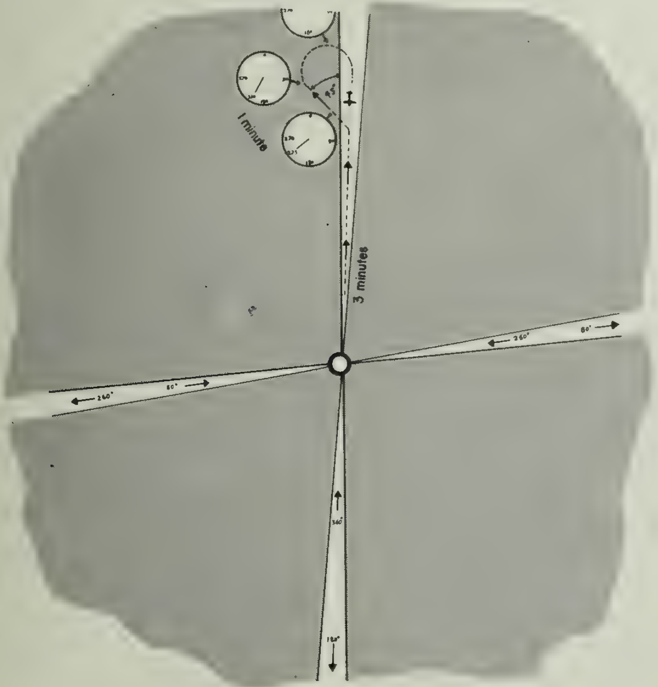
(Chart V)
Computing time and/or distance to station.

position, may be old hat to many of you. As a clincher, however, let us see what this little five degrees of silence can do for you in a bona fide emergency. Picture yourself in this kettle of fish.

The kerosene in your magnetic compass has been lost through a crack in the bowl. Your Fluxgate compass, or any other type you may have, is inoperative. Your HF and VHF radios are useless because of the static and equipment malfunction. The free air temperature is low enough to freeze your loop rotating mechanism in the position it happened to be in when you last used it. You have only an idea where you are and the soup is so thick you can't see your wingtips. What to do? Easy. Like shooting fish in a bucket. Your steps are as follows:

- Establish a gentle 360° turn to the right or left.
- With selector on loop, and CW-voice switch on voice, line up any radio station that the Facility Charts (T. O. 01-15-02) tells you is somewhere in your vicinity.
- Allow a minute of half or standard rate turn while checking for reception on each frequency you are trying for a signal. This will enable you to avoid missing any signals because of inadvertently being in a position where you would be getting a null on the station tuned in.
- Once you have a good clear signal, range or broadcast, stop your turn in the maximum signal position, and flip your CW-Voice selector to CW.
- Now begin a gentle turn, right or left, until you get a null.
- Hold this heading, using your turn indicator to do so, until the signal starts coming in again.

Method of approximating a one minute procedure turn on a three minute fly out from station.
(Chart IV)



- Make a gentle turn either to the right or left and pick up your null once more.
- According to the rules of precession, if you found it necessary to turn left to pick up the null, the station is off your left. If you turned right to relocate the null, the station is off to your right.
- Now make a timed turn in the appropriate direction, equal to the number of degrees of relative bearing indicated by the needle on the azimuth. Stop your turn and concentrate on keeping your turn needle centered.
- You are now headed toward the station.
- A strengthening signal, since you do not have a null at this time due to the cocked off position of the Loop, will confirm that you are inbound, and you can fly in until you effect station passage.

All of this at emergency altitude, or at least minimum safe altitude, for the area in which you are flying. No point in undoing a successful procedure by flying into a hillside.

Remember, practice makes perfect. A few dry runs in a Link, followed by a practice hop or two in an airplane, and chances are that you will become quite handy with an aural null and also will have added considerably to your longevity. Remember what I said at the beginning of this article? A pilot's best friend is his aural null. Right? ●

Knowing what to expect in the way of weather, particularly in the wintertime, can do much to make a flight a safe one.

# WHIMSICAL WINTER Weather

## When the snow starts to fly, smart pilots know the weather before they leap off into the gray

EXCEPT for an excursion into the rain-making business, science hasn't done much about regulating the weather. The men with the shiny laboratories and the mathematical brains can't surround your airplane with a 50-mile radius of CAVU conditions at all times. Short of that, however, they offer the pilot a lot. They have designed aids which enable you to fly through bad weather. And they have made it possible to forecast with reasonable accuracy what the weather will be along your flight path.

Knowing what to expect in the way of weather can do much to make your flight a safe one. This is particularly true during the wintertime.

### Three Things

When the pilot walks into the weather office just before winging off into the frigid air, he should be thinking about three things. The weather map will help him with all three. First, he should get in mind a complete picture of the current weather situation. Then, he should move the picture forward in space and time to cover the route of the flight. Finally, he should consider the changes that will occur during the entire trip.

The weather map gives such information in a pictorial form, and a brief survey of it, with the help of the forecaster, will show in a few minutes what would take hours to describe. Freezing levels, for instance, have been known to change as rapidly as a young lady's mind. The level may change radically within a short period of time or over a short distance. This is because of the change of air masses associated with frontal passages over various stations or with flying through a front. The pilot may anticipate variations by finding the freezing level

Even birds walk when it comes up freezing snow.

General knowledge of a region's winter weather is a must.

within each air mass over stations and considering the past movement of fronts and the approximate point at which the plane will fly out of one air mass and into another.

Two other familiar winter bugaboos—low ceilings and visibilities—also can be anticipated with the help of the weather map. The presence of a slow-moving warm or occluded front with precipitation ahead of it will bring the ceiling right down to the concrete. Visibility and ceiling are also affected by upslope fog, which is formed when air is lifted by prevailing winds up the slopes of mountains.

Some weather conditions, such as advection fog, are difficult to forecast. Advection fog may persist during the night but usually will become low stratus with ceilings of 100 to 500 feet during the day and, with sufficient heating, may break in the afternoon and form again about sunset. If, after consulting the weather maps, the pilot knows he is flying into such a doubtful area, he of course should be sure he has a good alternate.

Another winter problem, which may have been forgotten during the summer months, is the reaction of the pressure altimeter during flights into areas of different pressures or into cold air. Remember the altimeter will read too high when the airplane is flying from higher toward lower pressures. Flights into cold air will also have an effect on the altimeter. Since there is a rumor that some snow clouds consist primarily of mountain peaks, the altimeter error had best be planned for in advance.

Right now it might be a good idea to bone up on general ZI weather trends for the worst four months of winter flying weather.

## October

For all practical purposes, October in the United States can be classified as the prelude of things to come. The problems that start occurring in that month merely become magnified as the months go on. October usually is considered a fall month, but in some sections of the country it is marked by extremely poor flying weather.

This is particularly true in the Far Northwest, where October is typified by fogs and low ceilings. In the Seattle area, for example, visibility averages between absolutely nothing and one mile. This condition prevails about a third of the time during the hours of 0300 to 0900, markedly improves during the hours of 1200 to 1800.

October also must be labeled as a very poor flying month along the California coast, with the chances of heavy fog and low ceilings being greater than in any other month.

In the Middle West Plains states, October brings a few active cold fronts, one or two active lows and a tendency toward ground fog formation during the sunrise period. The average height of the freezing level drops down to between 10,000 - 12,000 feet.

The Central East Coast during October has alternating periods of stable, fog-laden air when highs become

**No matter where you do your winter flying, the chances are that during the winter months you will encounter some special weather conditions peculiar to your section of the country. Each year Flying Safety Magazine reminds the flyboys just what to expect in the way of weather for each general geographical section of the country, during October, November, December and January.**

**However, the smart pilot doesn't just concentrate on his own backyard. He learns the general weather trend for anywhere he may have to drive an iron bird.**

**Consult your weatherman. He's a good guy to know when the thermometer reads low.**

**Cold weather can affect your altimeter reading and some clouds have hard centers.**

stranded off the coast, in addition to general rain and low ceilings.

### November

Dark, rainy weather is typical throughout all of the Northwest during November. Interior areas are plagued with almost as much wet, foggy weather as the coastal sections. November ranks as the worst flying month of the year west of the Cascades, because of heavy snowfall in the mountains. The average height of the freezing level in the interior areas is down to about 7000 feet toward the end of the month.

The Las Vegas Area has the finest weather in November, but the rest of the Southwest is exposed to the first winter types of frontal and airmass weather. The rainy season is generally well established by early November. Through the Southwest part of the United States we find that the average height of the freezing level is down to about 8500 in the northern section and 10,000 in the southern section.

Around the Great Lakes Region, the instability effect is stronger during November, as cold masses of Canadian air move in across the warmer waters. The entire area has frequent blankets of stratocumulus clouds with accompanying snow squalls.

### December

Unlike the West Coast, the East Coast has a more gradual approach to the bad weather peak which comes in late December and January. Lowering of the freezing level sometimes nearly to the surface, plus lack of good alternates in the area, makes December and January on the East Coast relatively bad, weather-wise.

During December, the Northwest and Northeast sections catch the brunt of bad weather, although major storms are possible and highly probable anywhere in the country. The Eastern storms are more likely to create widespread low ceilings and fog. Strong downslope winds prevail for a week or more at a time and the East slope of the Rockies usually provides the best weather in December.

Also in December, the interior valleys of California offer the most consistent stretches of bad weather, as fog is often continuous for days at a time, interrupted only briefly by slight lifting during the afternoons.

### January

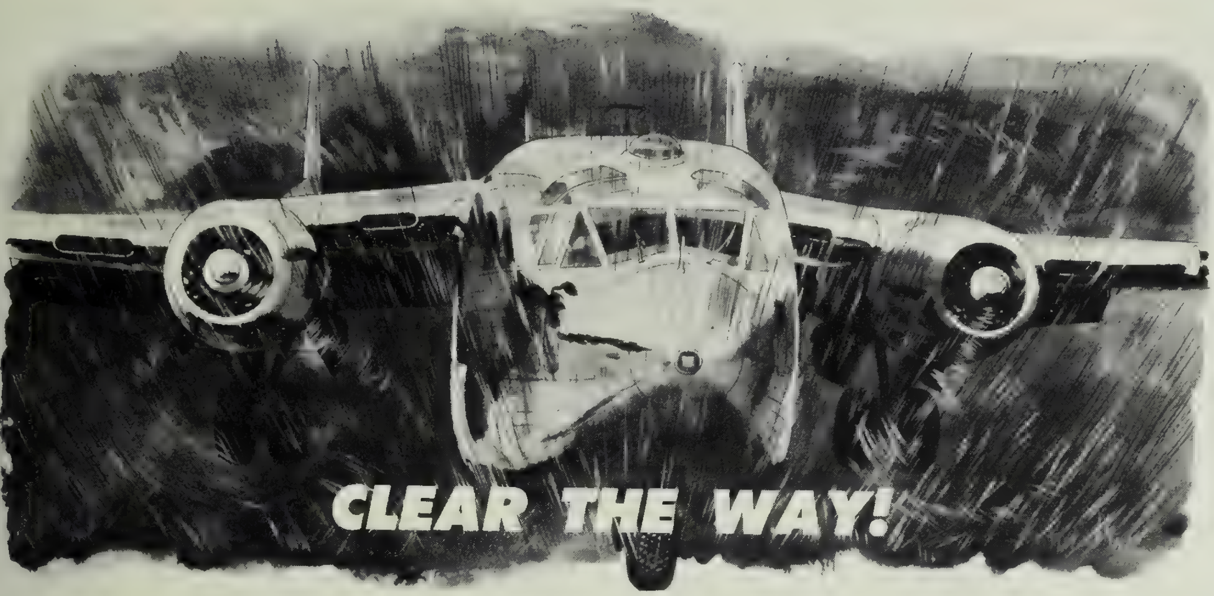
Considering the United States winter as a whole, January is the worst flying weather month of the year. Storm developments reach their peak of frequency and intensity, cold ground surfaces provide ideal conditions for fog formation, and airmass contrasts between ocean and continent are at a maximum.

Up in the Northwest, the entire area offers a continuation of the December pattern. The East slope of the Rockies again has the best flying weather because of the strong, westerly, downslope winds. January is the wettest month along most of the California coast, despite the local propaganda merchants, who make their livings from chambers of commerce. Fog is concentrated more heavily in the central valleys, but Nellis AFB and Edwards AFB are practically 100 per cent operational, and may be used as alternates most of the time.

Also in January, the Great Lakes and East Coast areas are particularly poor for flying. A high proportion of low ceiling and visibility occurs in connection with warm fronts lying to the south of the areas over the Carolinas or just off the coast.

That in brief is what can be expected during the wintertime in the United States. With the idea in mind that second-hand experience is sometimes best—and free, too—the wise pilot beginning a tour in an area outside the United States will learn from the old timers and the specialists what in general to expect from the weather. If this is your first winter in Japan, Okinawa, Northern Europe or some other part of the world away from the home shores, weather forecasters and pilots who have been there awhile can give you a lot of helpful tips on weather peculiarities.

With a general knowledge of the region's winter climate, a good weather briefing prior to flight, and proper preparation of equipment, no pilot is likely to encounter weather problems he can't handle. ●



# CLEAR THE WAY!

## Water repellent, not an eagle eye, is needed for rain-streaked windshields.

Over the years, all of us at one time or another have done a fair share of cussing and sweating when trying to ease an old bird down for a landing with an obscured windshield. Perhaps the screen was smeared with oil or rain or just plain foggy goo. In any event, it wasn't fun.

Probably the worst offender is rain. In any degree of intensity it's a potential troublemaker and when the clouds really let loose and drip, then the pilot often finds himself in quite a bind.

Both the Air Force and the Civil Aeronautics Authority have been working toward a solution to this visibility problem and several interim methods have been utilized with varying degrees of success.

Early this year the CAA published a Technical Development Report on distortion caused by rain on windshields. We are reproducing part of their findings below:

"It is a common experience to anyone who has looked through a rain-streaked window or has driven a car in the rain to see everything blurred and distorted. This effect is even more marked in the case of the pilot of an aircraft.

"The most difficult viewing tasks for the airplane pilot occur during approach and landing operations, particularly at night. The pilot is then dependent on a pattern of white and colored lights which he must be able to see and interpret correctly. These lights are signal lights rather than lights to illuminate the surrounding area. It is of the utmost importance, therefore, that they can be seen in their true relationship to each other and that the pattern with respect to the runway can be determined. Any distortion of the lighting pattern will hinder the pilot's effort and may delay or even prevent the landing of the airplane.

"The visual difficulties arising under conditions of rainfall can be assumed as resulting from the following factors:

- The rain between the airplane and the lights.
- The layer of water on the windshield.
- The effect of the air stream on the water on the windshield.

"Rain in the atmosphere between airplane and the lights will reduce the visibility of the lights. In addition to this reduction in visual range, the individual drops will cause scattering of the light and will tend to produce a halo around each light source. This condition is particularly evident when the droplets become small enough to result in fog instead of precipitation.

"The distortion resulting from the water flow over the windshield is caused by the varying thickness and non-uniform surface of the water. The curvature of the water surfaces causes the light incident on these surfaces to be refracted to varying degrees, and the image formed by this light is consequently distorted and partially obscured. In effect, the raindrops and water streaks form random lens surfaces over the wet area of the glass. This condition is magnified in a moving aircraft because its windshield intercepts a quantity of water that is nearly proportional to its forward velocity.

"The air stream blowing across the windshield during flight can have two counteracting effects. The motion of the air serves to blow the water off the windshield, thus tending to prevent the formation of a thick layer of water. With suitable flow lines, the air stream can even prevent some of the water from striking the windshield by deflecting the raindrops upward and sideways before they are intercepted by the glass. However, the effect of the air stream on water which does reach the windshield is to produce streaks, thus resulting in less uniformity of the water surface on the glass."

Type AA-1 rain repellent has been used with varying degrees of success for several years by the Air Force. It is generally agreed, however, that this agent leaves a great deal to be desired and recently WADC has given the green light for a newer product. This repellent is an anti-wetting compound known as Formula No. FC-10 and will soon be available Air Force-wide.

Properly applied to windshields, FC-10 holds tremendous promise and FLYING SAFETY would appreciate any first-hand reports of field experience with this compound. ●

# BAIL OUT
# and
# SURVIVE

"I just felt suspended in space . . . . ."

**This pilot found out that confidence in his emergency equipment was vital when planning a careful, safe ejection.**

### Procedure for Ejection

1. Pull bailout bottle (should be connected at takeoff for high altitude flights).
2. Visor down.
3. Police up cockpit connections (i.e., oxygen hose alligator clip, etc.,—primarily to effect clean separation from the seat).
4. Jettison canopy (be sure that head and body are down low in aircraft on which canopy "dishes." Check T. O.).
5. Lock shoulder harness.
6. Position self in seat (head back, feet in stirrups, arms in armrests).
7. Eject.
8. Separate from seat immediately. (The lap belt should be unfastened below 2000'.)
9. Pull ripcord (Delay pulling until below 25,000' and until you have decelerated to terminal velocity if altitude permits).

   NOTE: When time and altitude are at a premium, steps 4, 6, 7, 8 and 9 will suffice.

"I'M an ejectee! The main reason that I'm here to write my story is my ejection seat. Secondly, in my case is the fact that I had a wingman who gave me early warning of my difficulties.

"We took off in our F-86D's early one morning from an East Coast air base. The next four minutes were the most exciting in my life.

"Immediately after becoming airborne I discovered that I had lost my main flight control system. Notifying my wingman of the difficulties, I made a turn back toward the base, intending to make an immediate landing. The wingman advised that my aircraft was on fire in the vicinity of the right wing root. At this time I was flying at about 220 knots and altitude was 1000 feet. I could not see the fire from the cockpit nor at any other time while in the aircraft did I see or have any instrument indication of the conflagration.

"I continued a full power climbing turn back toward the base and asked my wingman if he thought that I could make it. He replied in the negative, stating a panel had just burned away and that the fire was increasing in intensity. He suggested an immediate bailout. Right then and there I resigned myself to an ejection and rid my mind completely of any other course of action.

"With casual clarity of thought, I loosened my safety belt and shoulder harness. Not being completely sure of my altitude, I decided to employ the low altitude bailout procedure. I raised the right armrest which immediately blew the canopy and at the same time my helmet was carried away.

"My helmet was equipped with a visor and I had intended to lower it before ejecting, but didn't feel that this act was necessary until after the canopy was gone. Apparently my lack of concern was based on numerous reports of canopy loss on takeoff without loss of the pilot's helmet. My case disproved that theory as far as I was concerned.

### Delayed Bailout

"I delayed my ejection for at least 30 seconds after the canopy had gone in order to police the cockpit. I carefully positioned the seat belt to avoid a possible snag, placed the shoulder harness straps neatly over my shoulders, and removed the oxygen hose clip from my clothing. Considering my predicament, I now consider these actions rather superfluous for they could have proved costly under any but an ideal condition. Had my aircraft been uncontrollable, this casual approach might well have put me on the statistical side of an accident report.

"At no time was the wind blast severe and I encountered no buffeting. No difficulty was experienced in operating the seat armrest or trigger and I was able to keep the airplane in a climbing turn to the right. Just before triggering out, I positioned myself and my last thought was, 'I wonder what the . . . this is going to be like.' I squeezed the trigger and was gone!

"My world turned into a gray nightmare of terrific blasts and indescribable gyrations. (My wingman saw me eject and stated that I made just one slow, fully outstretched flip, leaving the seat almost immediately on clearing the aircraft. He said that the seat and I both cleared the ship by about thirty feet.)

"When my faculties and power of sight returned, I was face down, fully spread-eagled. I had no sense of falling. I just felt suspended in space with a slight sound of rushing wind in my ears. I had no difficulty reaching the ripcord and assume that I would have had no difficulty in releasing my seat belt had I been wearing one. The chute blossomed out with a moderate shock and I glanced up and thought, 'Boy, that really looks beautiful!' It was a wonderful feeling to suddenly realize that I had made the grade. I had ejected at well over 300 knots and was all in one piece.

"I purposely delayed opening my chute until I was certain that my forward speed had slowed sufficiently to insure keeping the jump sack intact. By waiting until I could see, I had reasoned that I had slowed down sufficiently.

"I had no feeling of descending until the last few hundred feet when the ground appeared to rise toward me rapidly. I landed in a sod field (the only one for miles around) with a moderate 'thump.' The landing wasn't nearly as hard as I had expected. For the record I am six feet one and weigh 210 pounds.

### Controlled Chute

"During the descent I managed to control the oscillation pretty well, but came down all the way backwards. I knew the theory of turning, but the first attempt resulted in partial spillage of the chute and some additional oscillation. At this point I decided to leave well enough alone and just go along for the ride.

"My only injuries were two gouges on my forehead caused by the nose piece of my sunglasses. The glasses parted company when the oxygen mask was pulled over my face as the helmet was carried away. I also bruised my left ankle a bit, but I am sure that this was because I didn't have my left foot firmly in the stirrup at the time of ejection.

"My only previous parachute and ejection training had been lectures and the information contained in the Pilots Operating Instructions for the various aircraft I had flown. I feel, however, that this is adequate information for the accomplishment of a safe emergency ejection.

"As in any similar situation, I feel that I *could* have done it better but believe me I am more than satisfied with the outcome of this jump. Here are my mistakes, as I see them now:

1. The helmet visor should have been lowered prior to blowing the canopy.
2. The sunglasses should have been removed as soon as the emergency was recognized.
3. I should have planted both feet *firmly* in the stirrups.
4. Although I wasn't able to control my chute very well, almost any form of landing is preferable to dumping in backwards. (I was just lucky!)

"In a final summation, I can safely say that I believe the ejection seat is here to stay. Confidence in the mechanism leads to peace of mind. I knew that I would not hit any part of the airframe structure and consequently was able to carefully plan each step of my 99 and 44/100% safe ejection. If the necessity for bailout arises again, I'll be even better prepared as the result of this experience." ●

# CROSS FEED

## LETTERS TO THE EDITOR

### . . . . From Greece

Congratulations to Master Sergeant Keck and to the pilots of the 1002nd Inspector General Group for their outstanding record of 117 landings on one set of T-33 tires.

We, of the USAF Section, JUSMAG (Greece), are equally proud of the record here in Greece.

During the initial jet transition phase of the Royal Hellenic Air Force, considerable difficulty was encountered in the program because of a shortage of tires. However, this shortage, which threatened to retard the pilot training program from the very start, was met and solved by the RHAF pilots and mechanics themselves. Careful maintenance supervision on proper tire inflation and thorough briefing of pilots on brake usage enabled them to attain on a number of occasions between 120-130 landings per set of tires.

Most important of all, however, is the fact that this critical period led to the establishment of good flying and maintenance habits with the result that today they are bettering their previous record. During the period 2 February 1953—16 July 1953, an *average* of better than 120 landings were made per tire. Such an achievement on the part of one of our allies is worthy of our highest admiration.

**Captain S. Mamalis**
**JUSMAG (Greece)**
**APO 206, c/o PM, New York.**

★ ★ ★

### . . . . From Langley AFB

We've noticed the article on page 26 of Flying Safety Magazine for July 1953, concerning M/Sgt Keck's admirable record of 117 landings on his T-33 aircraft and requesting information on comparable records.

When our squadron, the 511th Fighter-Bomber Squadron, was stationed at Eglin AFB, Aux. #2, from November, 1952 through April, 1953, we accumulated some landings on our tires, the number of which we estimated to be slightly above average. We kept a cumulative daily total on the aircraft logs to aid us in planning our requirements for tires. We still have these records.

On our T-33, crewed by A/1C Winfred T. Seay, we accumulated 184 landings on one tire and 197 landings on its mate. We had two more tires that went to 164 landings; one tire to 170 landings; several to 140 plus landings, and a majority of our tires were landed upwards of 125 times.

We feel that we were able to do this because we had an 8000-foot runway that was asphalt-gravel topped, and also because of a braking technique evolved by our Squadron CO, Maj. Charles H. Spencer, and our Operations Officer, Maj. William O. Sneed.

The technique designed by our CO and Ops Officer was to land 1000 feet down the runway—because of unfavorable approaches, and then roll free for 4000 feet, using the final 3000 feet for braking. The braking action used was the rolling friction type and the brakes were held from two to three seconds and allowed to cool for at least an equal period before braking action was re-applied.

**Capt. Daniel S. Elliot**
**Asst Ops Officer**
**511th FBS Oprns, Langley.**

★ ★ ★

### . . . . From Bryan AFB

On page 26 of FLYING SAFETY for July, 1953, M/Sgt Keck looks very doubtful about 117 landings being a record for a pair of 26 x 6.6 tires, and for good reason we think!

From November, 1952, through April, 1953, we conducted a service test on retreaded 26 x 6.6 tires and we have reason to believe that the results might be of interest to the 1002nd IG Group.

One hundred ninety eight (198) tires were made available for the test. Two of these tires were found to be faulty prior to installation, leaving 196 tires that were actually tested. Ninety six (96) of the tires tested had more than 117 landings at the time of removal. In fact, one of these tires had a total of 233 landings.

Records were kept numerically by test number which would necessitate extensive research to determine the landings on each set. A quick check, however, revealed that the tires removed from Aircraft 51-6778 had the following number of landings:

| Serial No. | Test No. | Pos. | Date Rem. | No. of Ldgs. |
|---|---|---|---|---|
| TT 1739 | 9 | Left | 4-2-53 | 187 |
| 004525565L | 9 | Right | 4-2-53 | 215 |

We might mention here that these tires were installed on T-33A aircraft used in training student pilots.

**Maj. Wm. Greenwood**
**3530th Plt Trng Wing**
**Bryan AFB, Texas.**

★ ★ ★

### Preflight Service

I wish to echo the sentiments of Captain Garrison's Crossfeed item, "What, No Screw Driver?", in September FLYING SAFETY.

Flying F-51s from Hq USAF flight facilities has forced me to carry a tool kit, i.e., screw driver and water pump pliers, since tools are necessary to perform an adequate preflight safety check on fuel, oil, and in the case of the F-51, coolant.

Another gripe I have is the caliber of service performed at some airfields. For instance, on my last trip to the West Coast, my preflight inspection at two stops resulted in finding the oil cap on top of the oil tank, or hanging at the end of its chain. This happened three times within a year and twice at the same place.

It seems to me that Flying Safety would have a real interest in this type of service and that our safety record definitely will be related to the number of mistakes made in this manner. And with the advent of jet aircraft, well this becomes many, many more times serious.

This should serve to point up the need for pilots to be sure to check their aircraft prior to takeoff.

**Lt. Col. Donald L. Rodewald**
**Hq, USAF.**

★ ★ ★

### NOTAMS in Color

The question of checking NOTAMS along a proposed route has always been one in my mind which was determined by the length of time I had to wait to get my airplane gassed or had to wait for a passenger.

Almost all of the operations offices that I have visited have Kardex files with NOTAMS filed by States. To check a flight path properly, it required looking into several drawers while consulting a map to determine your flight path. Needless to say this has been rarely done. We have a system at Kirtland AFB which should simplify the matter, and although it may not be original, I have never seen a similar layout.

In essence it is a NOTAM index with each NOTAM on file indicated by a colored pin placed on a (AP-9) map. The color of the pin indicates the type facility reported. By tracing your flight path along the map you can determine, by the location of the pins and their color, whether the NOTAM will influence your flight.

The colors utilized at this station are:

| *Color* | *NOTAMS pertaining to:* |
|---|---|
| Maroon | Condition of runways, taxiways, aprons, etc. |
| Green | Servicing, fuel non-availability, etc. |
| Black | RON Restrictions—Qtrs. |
| Orange | Firing—AA—Bombing. |
| Yellow | Official Business Only. |
| Purple | Airfield Lighting. |
| Gold | Landing Aids—ILS—GCA. |
| Blue | Radio Aids—Range, VAR, VOR. |
| Lt. Green | Instrument Flight Restrictions and Procedures. |
| Pink | Night Operation Restrictions and Hours. |

Thus a pilot tracing his flight path would not have to look at NOTAMS other than those marked BLUE or ORANGE unless he contemplated landing, and would not have to check those for BLACK at his destination if he planned to stop for servicing.

By simply placing a pin when filing a NOTAM, and removing it when withdrawing one from the file, the board is kept up to date.

It is believed that if this system is implemented at other bases that pilots would be encouraged to check the pertinent NOTAMS. By using the same colors, pilots would soon know the significance of pins and it would reduce the need for checking the color code.

**Capt. James R. McCullough**
**Asst Base Ops Officer**
**Kirtland AFB, New Mexico**

★ ★ ★

### No "Breath of Life"

On page seven of the July issue of FLYING SAFETY appears an article on the D-1, D-2 series of oxygen regulators entitled "The Breath of Life."

In the next to the last paragraph, a statement is made that the D-2 will sustain life at altitudes up to 80,000 feet, provided the proper counterpressure exists. The D-2 regulator does not differ in operational ceiling from the D-1 in this respect. Neither regulator can sustain life at 80,000 feet. The maximum altitude for extended periods of time using either the Type D-1 or D-2 regulator is 43,000 feet. Both regulators may be used for a few minutes in emergencies at altitudes up to 48,000 feet. . . .

For your information, all D-1 regulators are being scheduled for rework into the latest Type D-2 configuration so that within the next year all regulators of this series should be identical.

It is true, as stated in the final paragraph, that the D-2 will soon be used in conjunction with the T-1 High Altitude Suit; however, an additional "emergency" regulator is required for this purpose. This regulator is attached to a high pressure cylinder and the combination is known as the Type C-1 cylinder and regulator assembly. The assembly provides oxygen not only for pressurizing the suit, but also delivers a high positive pressure to the mask which in effect overrides any pressure delivered from the D-2 regulator. It is intended to serve in emergencies if the cabin pressure fails at altitudes above 43,000 feet.

**Donald R. Good**
**Chief, Eng. & Dev. Br**
**AeroMed Lab**
**Wright-Patterson AFB.**

★ ★ ★

*Our proofreader is rolling in sackcloth and ashes. And we thank you for writing us.*

★ ★ ★

### Airscoop Landing

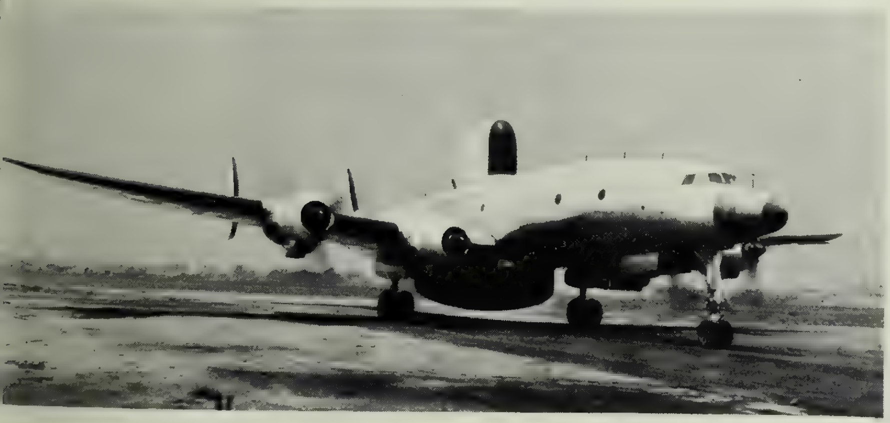
We've read the Keep Current item, "F-51 Retracted Tailwheel," from a recent issue of FLYING SAFETY. The answer to landing an F-51H with a retracted tailwheel is to lower the scoop to full manual position and land on the scoop. This has been done several times with only minor sheetmetal work required on scoop.

**Col. John B. Coleman, USAF**
**Senior Air Instructor**
**Dept. of Military Affairs**
**State of Pennsylvania**

★ ★ ★

*This is a new "scoop." Do any peashooter pilots wish to add to or comment on Colonel Cushman's recommendation? The new T. O. for the F-51H calls for the tailwheel to be down and manually locked at all times. However, if the tailwheel is not faired in well, there is a remote possibility of exhaust fumes being drawn back up into the cockpit.*

**USAF's new RC-121C carries six tons of electronic equipment. The dorsal-like hump on the back, the bulge underneath and the elongated nose house radar antennae. It is powered with turbo-compound engines and cruises over 300 MPH.**



# WELL DONE!

FOR many years FLYING SAFETY has recognized outstanding feats of airmanship through the medium of the "Well Done" page. We feel that the least we can do is salute the individual or group who performs in an outstanding manner under the stress of emergency.

Because of a recent change in "Well Done" policy, however, a word of explanation is in order.

The Office of the Deputy Inspector General, USAF, has notified all major commanders that in the future, nominees selected for recognition in the "Well Done" feature of Flying Safety Magazine *will be recommended for commendation by the Chief of Staff, USAF.*

Major commanders have been invited to submit their own nominations for "Well Done" recognition and a board of officers in the office of the Deputy Inspector General will make final selections.

Recipients of the "*Well Done*" award will also receive the original artwork, as prepared for publication in Flying Safety Magazine.

When no nominations considered worthy of recognition are received, a "*Well Done*" feature will not be used that month. Only those persons considered to have performed outstanding feats of airmanship and thereby have prevented a serious accident will be eligible for the recognition.

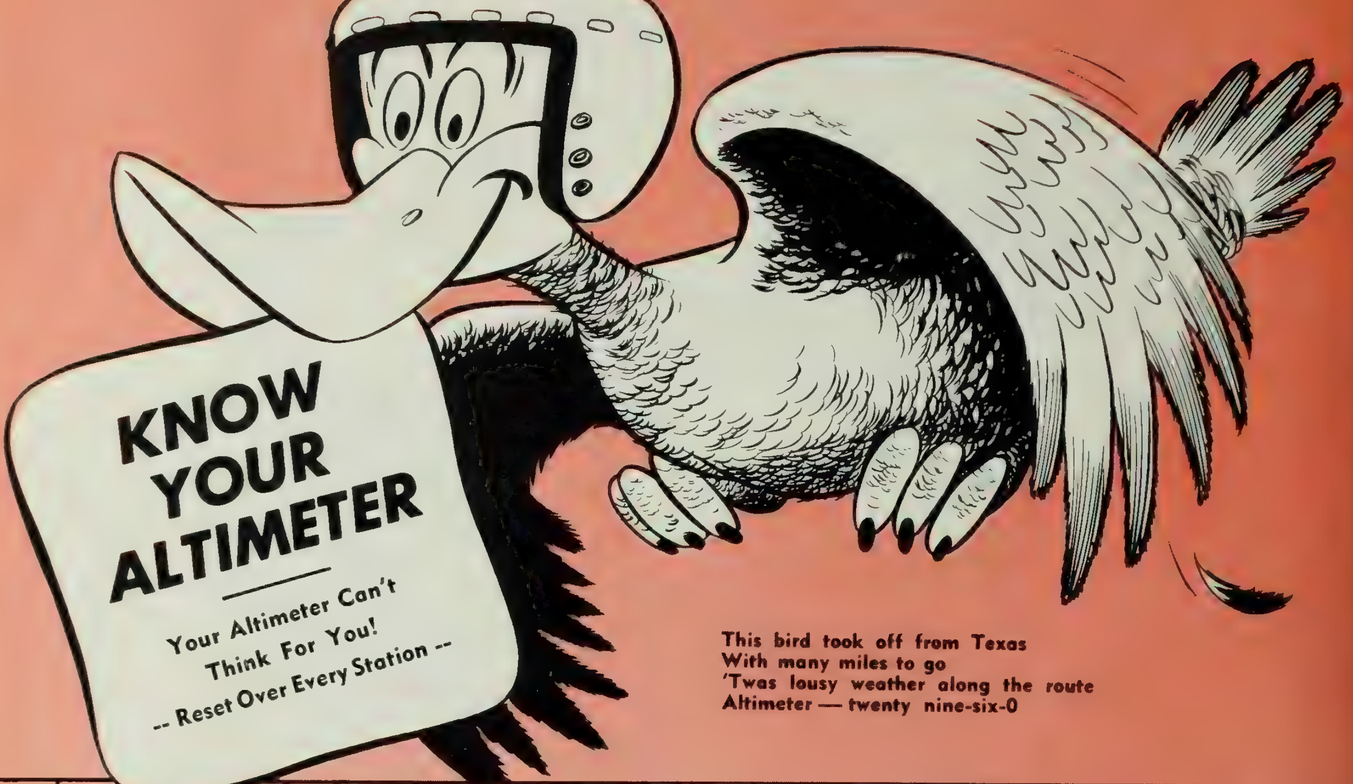
In the event a nomination for "*Well Done*" recognition is received from an individual or subordinate unit, such nomination will be referred to the appropriate major commander to determine if he wishes to endorse it as his official selection.

FLYING SAFETY welcomes this procedure. We feel that a wider choice of nominees will now be possible and insure giving recognition for the *best "Well Done."*

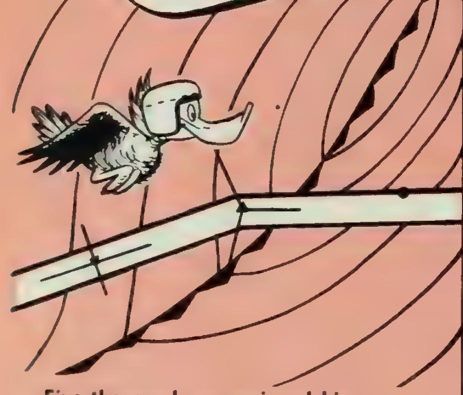
# Streamlined on Ice...

For skating, that is. For flying it's a different story altogether. On your airplane, clear ice usually starts forming by closely following the wing contour, and builds forward in a blunt, unstreamlined mass. When you do encounter clear ice, just bear in mind that, like the skaters, you must keep your airspeed on the high side when you make those turns.

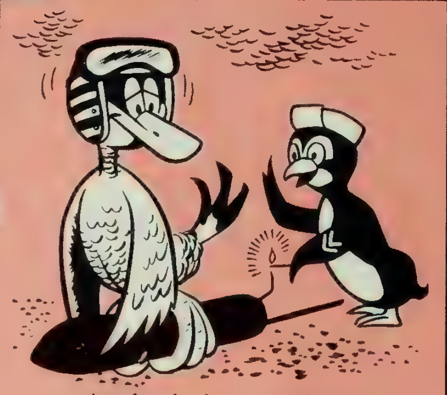
## don't be a warm weather pilot in winter -- watch for ice!


KNOW YOUR ALTIMETER
Your Altimeter Can't Think For You!
-- Reset Over Every Station --

This bird took off from Texas
With many miles to go
'Twas lousy weather along the route
Altimeter — twenty nine-six-0

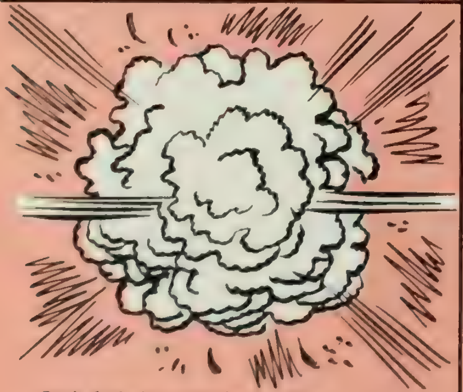


Five thousand was assigned him
And cold fronts forecast, too,
But he forgot 'bout pressure change—
Kept boring right on thru . . .

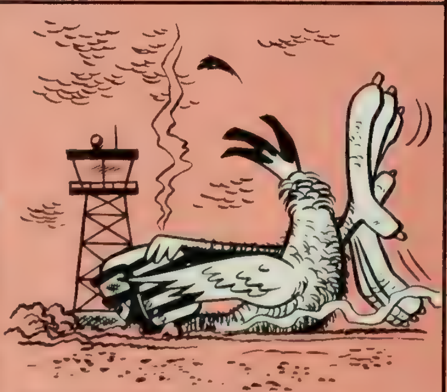


Another bird was westbound
Six thousand was assigned
Altimeter set for thirty-six
And here now comes the bind

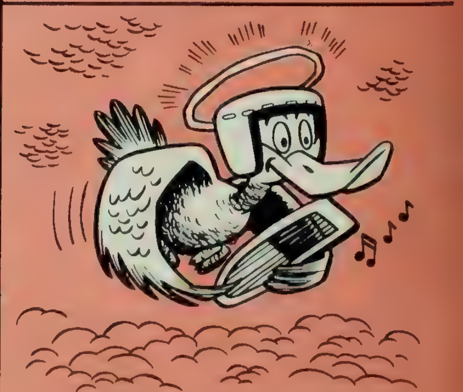
They both held altitude right well
According to their clocks,
Forgetting that in frontal passage
Pressure climbs or drops



Both failed to call for settings
While stations sizzled by
They both homed in on one last range—
They met there, in the sky



One spun down into the ground
The other got away
Though ripped and torn and really shook
He'll fly again some day



Had both these birds checked pressure
Along the right of way
'Tis plain to see that two—not one
Would be with us today.

☆ U. S. GOVERNMENT PRINTING OFFICE 1953---271138

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FLYS

# FLYING SAFETY

UNITED STATES AIR FORCE

DECEMBER, 1953

THE LIBRARY OF THE
UNIVERSITY OF ILLINOIS

*Holiday Greetings*

**This month Flying Safety presents you with a special all-jet issue.**

# FLYING SAFETY

**VOLUME NINE**

**NUMBER TWELVE**

Department of the Air Force
The Inspector General USAF
Major General Victor E. Bertrandias,
Deputy Inspector General

★ ★ ★

Brigadier General Richard J. O'Keefe
Director
Directorate of Flight Safety Research
Norton Air Force Base, California

★ ★ ★

Colonel John R. Dahlstrom
Supervisor of Flight Safety
Publications

★ ★ ★

**There is no "Well Done" this month since no nominations were received in time due to the new selection procedures now in effect.**

★ ★ ★

Are you sure of your ejection procedures? If not, see page 14.

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**COVER:** "Christmas At Home," by S/Sgt Nicholas Shekitka

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★ ★ ★

## SUBSCRIPTIONS

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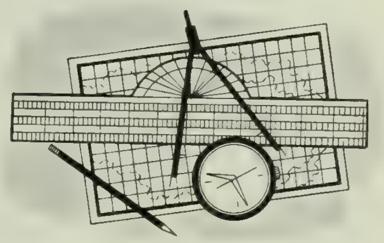
★ ★ ★

The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payment can be made for manuscripts submitted for publication in FLYING SAFETY magazine. Contributions are welcome as are comments and criticisms. Address all correspondence to the Editor, FLYING SAFETY magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Non-Air Force organizations must query the Editor before reprinting, indicating how the material will be used. The contents of this magazine are informational and should not be construed as regulations, Technical Orders or directives unless so stated.

USAF PUBLICATION 62-1

**Careful flight planning pays off in safety. Don't take unnecessary chances trying to save some time.**



# PLANNING YOUR FLIGHT

THE problems in jet flight planning are not entirely new. Most of them are the big brothers of the problems which arose in flying conventional aircraft. Endurance, range, weather; all the old problems are still here. With a jet, however, the newest wrinkle is the combination of short endurance and comparatively long range. This range, in turn, means a larger variety of weather on a single flight. In short, the jet lumps several old problems together and tosses them in your lap on every flight.

There's little that is drastically new in the solution of these problems. It's still called flight planning, only now it's done in greater detail.

There is one system, however, that pays off every time. It's been proven in flight to be basically sound, and, if used properly, guarantees no unscheduled hikes from the "boondocks" to destination.

It's a system that entails more work than the average pilot ordinarily devotes to the business of going from here to yonder. But out of the detailed planning on which the system is based have come Climb Compensation Charts and Flight Logs that actually simplify jet flight planning to the point where the time factor is no longer prohibitive.

## Check The Weather

It all starts with a trip to the weather office. You're covering a lot of ground in a short time and you can expect fairly rapid changes in the weather through which you are travelling. If a check on the weather reveals that your flight can be conducted under visual flight rules, the problem is made easier. But where instrument flight conditions are forecast, detailed flight planning is a must for consistently successful jet flight.

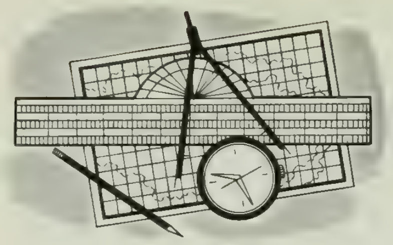
Let the forecaster know what you want. Tell him the type aircraft you are flying, altitudes you expect to fly, your ETE and any additional information which will assist him in visualizing your problem. Once you have given the forecaster this information, he is then equipped to brief you fully and accurately on the weather that will affect your individual flight. When getting your weather briefing, remember to get forecast as well as existing weather. When the forecaster has finished his briefing, you should have the following data:

*Destination:* Ceiling, visibility, freezing level, tops of clouds and precipitation.

*En route:* Ceilings, visibilities, cloud types at flight altitudes, tops of clouds, turbulence, temperatures aloft and winds at flight altitudes.

*Takeoff Point:* Ceiling, visibility, freezing level and temperatures and winds up to flight altitude.

Sounds involved, doesn't it? But it's only a matter of minutes to get



this information. Once you have it, you have all the weather information necessary to plan an instrument flight successfully, and, equally important, you have the answer to that big question, "Where's the best place to go?" if an inflight emergency occurs.

Knowledge of the ceiling, visibility and freezing level at your destination is imperative. It's also vitally important to know the type and intensity of precipitation which exists or is forecast at your destination. Poor cockpit visibility may turn an otherwise routine approach into a fast session of low level aerobatics with disastrous results.

Temperatures and winds up to flight altitudes must be known to compute accurately the distance to be covered during your climb and the fuel to be consumed.

With a complete picture of en route ceilings and visibilities, valuable time is saved when an aircraft malfunction or other emergency forces you to decide where you can land with the least difficulty.

The types of clouds at flight altitudes will give the pilot a good idea of the kind of low frequency radio reception he will have. The presence of turbulence in the ice crystal zone will virtually assure that corona static will be present. Frequently ice crystal clouds will cause corona static of such intensity that the low frequency radio will be useless and navigation must be dead reckoning.

Weather at takeoff point is an item often neglected in flight planning. Knowledge of this weather will be the deciding factor when a decision must be made either to return to destination or continue to an alternate in the event of an emergency soon after takeoff. A forecast on weather at takeoff point may bring out a future weather condition not apparent to the casual observer.

Alternates should be chosen approximately 200 miles apart, or if possible, within gliding distance of the aircraft. Once selected, they are then readily available if the need for an alternate arises anywhere along the route of flight.

### Operations Facilities

Loaded with your weather information, you're then ready to visit the operations office for a check of the radio facilities along the proposed route of flight. The Radio Facility Chart, AN 08-15-1, is your best source of this information. Your destination should be checked for length of runways, airport elevation, type of fuel available and jet starting unit. You should also check the status of radio range, GCA or ILAS, homing facilities, VHF/DF homer and obstructions (found in Pilot's Handbooks).

This information should be collected for each alternate airport. A check of NOTAMS will give the latest information pertaining to radio facilities and airport condition.

When you've completed your check of weather, radio facilities and airport condition, then make the final plans on your route of flight. If maps are used to plan the route, be sure to check all radio facilities against the Radio Facility Charts, NOTAMS and The Airman's Guide.

At this point in your planning you are a fountain of information, but oddly enough the time consumed in gaining this information is not prohibitive. About thirty minutes should give you the complete picture. Starting in the weather office and then working into operations eliminates those many trips back and forth picking up information which could have been gained in one chat with the forecaster. Then too, if one piece of the information which you have helps to avoid walking home from your flight, you'll have saved one whale of a lot of time in the long run.

Forecasting your fuel requirements and flight time is your next step. Using the proper techniques, it is possible to forecast fuel requirements within ten gallons and flight time within two minutes.

**Knowing the exact amount of fuel aboard and following the checklist are musts for good flight planning.**

# CLIMB · CRUISE · LETDOWN

NORMALLY, jet aircraft climb to high altitudes (25,000 to 50,000 feet) at high indicated airspeeds (200 to 450 knots). Naturally, this means a large quantity of fuel is burned in the climb and a considerable distance over the ground is covered before reaching cruising altitude.

Because of these facts, the climb assumes extreme importance in jet flight planning. In fact it's possible to deal yourself right out of the card game in the climb, by neglecting to figure how much fuel you'll have in your "poke" when you hit the cold blue yonder.

The rate of climb will affect the time for the climb and the fuel used during the climb. The most important factor determining the rate of climb is the temperature of the air through which the aircraft is climbing. The higher the temperature, the lower the rate of climb for any given power setting and altitude.

The distance flown during the climb will depend on the true airspeed, time spent in the climb and wind velocities at the various altitudes through which the aircraft passes.

It's obvious, even at this point, that we need some performance data, rates of climb for instance, on a certain type aircraft before we can go much further. The Pilots Flight Operating Instructions for your particular aircraft will give you the information you need. The examples in this article are based on flight data for the T-33A, but the procedures are applicable to any jet aircraft when performance data for that particular aircraft is substituted.

Climb data that we need are found in the climb chart of the Flight Operating Instructions. Typical climb charts are on page 5. Data contained in these climb charts are based on a standard day. A standard day is the slipstick driver's answer to the average man, "there hardly ain't no sech animal." A standard day is a day at 40° latitude when the temperature is 59° F., pressure is 29.92 and the adiabatic lapse rate is 3.55° per thousand feet.

Since these climb data are based on such a day, most climbs will have to be computed for the actual flight conditions existing at the time of the climb. The climb chart carries a note which explains how such computation is carried out: "To correct Rate of Climb values for air temperature different from standard day temperature, subtract 35 feet per minute from the Rate of Climb for every degree Fahrenheit above standard day temperature for both clean configuration and drop tank configuration." Uh huh!

You'll also note, in Fig. 1, that the climb chart gives a rate of climb for an altitude, the time to climb each 5000 feet, the fuel used to each 5000-foot level and the calibrated airspeed (CAS) for the climb.

If the chart is to be used properly, it should be clarified. The rate of climb shown opposite each 5000-foot level is the rate of climb at the given CAS as the aircraft passes through that level and not the average rate of climb through 5000 feet of altitude.

For example, on the chart opposite the 5000-foot level, the rate of climb is 3350 fpm and the time is 1.4 minutes. This doesn't mean that a rate of climb of 3350 fpm was flown for 1.4 minutes. It means that at the 5000-foot level, the rate of climb was 3350 fpm and the elapsed time from sea level to 5000 feet was 1.4 minutes.

To determine the approximate average rate of climb to 5000 feet, just take the average of the rates of climb at sea level (3850 fpm) and at 5000 feet (3350 fpm). Thus, the approximate average rate of climb to 5000 feet is established at 3600 fpm on a standard day.

By using the average rate of climb on a standard day and applying a temperature correction, the corrected rate of climb can be established. Once we've got the corrected rate of climb we're in business, since we can then compute the elapsed time, fuel used to climb each 5000 feet, and the distance flown during the climb.

### Temperatures

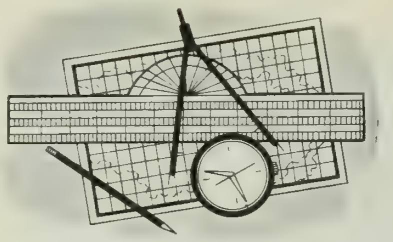
Somebody mentioned temperatures. The adiabatic chart gives the standard day temperatures for all altitudes. It also gives the actual temperatures at all altitudes. The weatherman will be of great assistance in helping you to get actual temperatures from the chart.

To figure our way from sea level to 5000 feet, we first get the average standard day temperature between these levels, i.e., the temperature at 2500 feet. Then here's what happens.

The standard day temperature at 2500 feet is 50°F. Let's assume that the adiabatic chart shows the actual temperature at 2500 feet to be 80°F. This is 30° warmer than the temperature for a standard day at that altitude. As instructed by the tech order, we multiply the difference in temperature (30°) by 35 fpm, and find that the corrected rate of climb will be 1050 fpm less than on a standard day or 2550 fpm (3600 minus 1050 fpm).

Once we have corrected rate of climb, it's a simple matter to set up a ratio on the E6B Computer between the standard day rate of climb and the corrected rate of climb. Set 2550 on the inner scale opposite 3600 on the outer scale, then opposite 1.4 on the inner scale (time for the climb on a standard day) read 2.0 on the outer scale. This is the time in minutes required to climb to 5000 feet at the corrected rate of climb. Without changing the computer setting, read the corrected fuel for the climb on the outer scale opposite 20 on the inner scale (gallons of fuel necessary for climb on standard day). In this case, 28 gallons.

Now, notice on the climb chart



that a CAS of 275 knots at sea level is indicated. On an average, the T-33 requires two minutes and 30 gallons of fuel for takeoff and acceleration to climbing airspeed (270 knots CAS). Since the climb is not started until that CAS is reached, we tack two minutes and 30 gallons to our previous findings. Consequently, the aircraft would pass through the 5000 foot level 4.0 minutes after takeoff roll was started and would have burned 58 gallons.

Now, how far have we flown? We started on the deck at 275 knots. As we pass through the 5000-foot level our calibrated airspeed as shown on the climb chart should be 265 knots. Therefore, we have held an average CAS of 270 knots from sea level to 5000 feet. Using this average CAS, the average temperature and the average altitude (2500 feet), we compute our true airspeed.

### Use Winds

Use the forecast winds at 2500 feet and apply them to the TAS, using the wind face of the computer. This will give you the groundspeed and the wind correction angle to 5000 feet. In some cases the wind velocity and/or the true airspeed is too high to be used on the wind face of the computer unless divided by two or three. Be sure to divide both by the same number and also be sure to multiply your result by the same number. Your wind correction angle need not be multiplied as it will remain constant.

When you have your groundspeed, multiply it by the corrected time for the climb (2.0 minutes) and compute the distance flown in the actual climb. To this distance add three miles, the distance flown in accelerating to 275 knots CAS. The result is the distance which the aircraft will be from takeoff point when passing through the 5000-foot level.

Using the same method, you can compute the rate of climb, time, fuel and distance flown for each 5000 feet up to cruising altitude, and enter them on an appropriate log. Add the times required for each 5000 feet of climb to get the total time for climb to cruising altitude.

In like manner, the fuel used and distance flown during the climb can be ascertained. A typical flight log in the summer in southeastern United States would indicate the following data: time to climb to 35,000 feet—30.2 minutes; fuel consumed to 35,000 feet—240 gallons; distance flown in the climb—197.4 miles.

This method of computing corrected climb data is basically sound and is valuable in training pilots in basic theory of jet cruise control. However, the time necessary to correct the climb data makes it impractical for everyday use.

For normal use in correcting climb data, a Climb Compensation Chart should be compiled for the specific type of jet aircraft being flown. Such a chart is constructed by computing the corrected rate of climb, time necessary to climb, fuel to be used and true airspeed for each 5000 feet of climb for various temperatures normally found at the different altitude levels.

The chart is based on the average temperature and the average rate of climb for each specific 5000 feet of altitude on a standard day. For example, the rate of climb used as the basis for the climb from sea level to 5000 feet is the average of the sea level rate of climb (3850 fpm) and the rate of climb at 5000 feet (3350 fpm) or 3600 fpm, on a standard day. You can compute the average rate of climb for the various average altitudes (2500, 7500, etc.) on a standard day for each 5000 feet of climb listed in the same way.

Centigrade temperatures should be used in compiling the chart since the temperatures received from the forecaster are normally in Centigrade. For each degree Centigrade that the temperature is above or below the standard temperature for that altitude, 63 feet per minute should be subtracted from or added to the average rate of climb for a standard day. This results in a corrected rate of climb. This corrected rate of climb can be used in turn to compute the corrected time and fuel for the climb through each 5000 feet of altitude.

To use the Climb Compensation Chart, the pilot has only to get the average temperatures in degrees Centigrade and the winds aloft for each 5000-foot increment of the climb, using surface 2500, 7500, 12,500-foot levels, etc. This takes about five minutes in the forecaster's den. Then whip out the chart and opposite the applicable level find the temperature. Immediately below the temperature, read off corrected rate of climb, corrected time, fuel to be used and true airspeed. That's more like it, isn't it?

If the temperature you have is not on the chart at the applicable level,

### TAKE-OFF SUMMARY

(Feet)

Airplane Model(s)
T-33A

70% (31.5° FLAPS, HARD SURFACE RUNWAY)

Engine Model(s)
J33-A-23 or -35

| CONFIGURATION AND GROSS WEIGHT | PRESS. ALT. (FEET) | −5 Degrees Centigrade | | | | +15 Degrees Centigrade | | | | +35 Degrees Centigrade | | | | +55 Degrees Centigrade | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ZERO WIND | | 30 KNOT WIND | | ZERO WIND | | 30 KNOT WIND | | ZERO WIND | | 30 KNOT WIND | | ZERO WIND | | 30 KNOT WIND | |
| | | Ground Run | Clear 50 Ft | Ground Run | Clear 50 Ft | Ground Run | Clear 50 Ft | Ground Run | Clear 50 Ft | Ground Run | Clear 50 Ft | Ground Run | Clear 50 Ft | Ground Run | Clear 50 Ft | Ground Run | Clear 50 Ft |
| (Two 230 gal. | S.L. | 2575 | 3825 | 1400 | 2375 | 3200 | 4925 | 1825 | 3100 | 4100 | 6275 | 2375 | 4025 | 5150 | 7900 | 3025 | 5125 |
| tip tanks) | 1000 | 2750 | 4150 | 1575 | 2600 | 3500 | 5350 | 2025 | 3400 | 4475 | 6850 | 2650 | 4500 | 5675 | 8675 | 3425 | 5700 |
| 15,500 Lb. | 2000 | 2975 | 4525 | 1750 | 2850 | 3810 | 5825 | 2225 | 3750 | 4900 | 7475 | 2975 | 5025 | 6250 | 9525 | 3825 | 6375 |
| Without | 3000 | 3250 | 4925 | 1925 | 3150 | 4150 | 6350 | 2475 | 4150 | 5350 | 8175 | 3275 | 5575 | 6850 | 10450 | 4250 | 7125 |
| Water | 4000 | 3550 | 5350 | 2100 | 3475 | 4525 | 6900 | 2725 | 4550 | 5850 | 8925 | 3600 | 6075 | 7525 | 11450 | 4650 | 7875 |
| Injection | 5000 | 3825 | 5825 | 2275 | 3800 | 4925 | 7500 | 2975 | 5000 | 6350 | 9750 | 3950 | 6500 | 8225 | 12500 | 5150 | 8575 |
| (Two 230 gal. | S.L. | 2100 | 3250 | 1175 | 2050 | 2650 | 4200 | 1500 | 2675 | 3350 | 5375 | 1950 | 3500 | 4200 | 6800 | 2475 | 4450 |
| tip tanks) | 1000 | 2275 | 3550 | 1300 | 2275 | 2900 | 4575 | 1675 | 3025 | 3675 | 5875 | 2200 | 3900 | 4600 | 7450 | 2775 | 5125 |
| 15,500 Lb. | 2000 | 2475 | 3875 | 1425 | 2475 | 3150 | 5000 | 1875 | 3325 | 4025 | 6425 | 2425 | 4325 | 5025 | 8150 | 3075 | 5525 |
| With | 3000 | 2700 | 4225 | 1550 | 2700 | 3425 | 5475 | 2050 | 3625 | 4400 | 7050 | 2675 | 4750 | 5500 | 8950 | 3400 | 6150 |
| Water | 4000 | 2925 | 4600 | 1675 | 2950 | 3750 | 5975 | 2250 | 3950 | 4775 | 7700 | 2925 | 5225 | 6050 | 9825 | 3725 | 6750 |
| Injection | 5000 | 3175 | 4975 | 1850 | 3250 | 4050 | 6500 | 2425 | 4300 | 5200 | 8425 | 3175 | 5700 | 6625 | 10775 | 4075 | 7400 |

## MAX POWER CLIMB CHART

Airplane Model(s)
T-33A

100% RPM
NACA STANDARD DAY
CONFIGURATION: Two 230 Gal. Tip Tanks
GROSS WEIGHT: 15,100 Lb.

Engine Model(s)
J33-A-23 or -35

| RATE OF CLIMB | FROM SEA LEVEL Distance | Time | Fuel | CAS (Knots) | PRESSURE ALTITUDE FEET |
|---|---|---|---|---|---|
| 3850 | 0 | 0 | 30 (1) | 275 | Sea Level |
| 3350 | 6 | 1.4 | 50 | 265 | 5,000 |
| 2850 | 14 | 3.0 | 70 | 255 | 10,000 |
| 2400 | 23 | 4.8 | 90 | 245 | 15,000 |
| 1950 | 35 | 7.2 | 111 | 235 | 20,000 |
| 1500 | 50 | 10.0 | 134 | 225 | 25,000 |
| 1100 | 71 | 13.8 | 160 | 215 | 30,000 |
| 750 | 103 | 19.1 | 189 | 205 | 35,000 |
| | | | | | 40,000 |
| | | | | | 45,000 |

## NORMAL POWER CLIMB CHART

96% RPM
NACA STANDARD DAY

| RATE OF CLIMB | Distance | Time | Fuel | CAS (Knots) | PRESSURE ALTITUDE FEET |
|---|---|---|---|---|---|
| 2950 | 0 | 0 | 30 (1) | 275 | Sea Level |
| 2500 | 8 | 1.8 | 52 | 265 | 5,000 |
| 2150 | 18 | 4.0 | 73 | 255 | 10,000 |
| 1750 | 31 | 6.5 | 96 | 245 | 15,000 |
| 1350 | 48 | 9.8 | 120 | 235 | 20,000 |
| 950 | 71 | 14.1 | 147 | 225 | 25,000 |
| 650 | 105 | 20.2 | 179 | 215 | 30,000 |
| 350 | 165 | 30.4 | 227 | 205 | 35,000 |
| | | | | | 40,000 |
| | | | | | 45,000 |

NOTE: (1) Warm-up and take-off allowance

## MAX RANGE SUMMARY

Airplane Model(s)
T-33A

Engine Model(s)
J33-A-23 or -35

NACA STANDARD DAY

| CONFIGURATION: Two 230 Gal. Tip Tanks GROSS WEIGHT: 15,100 Lb. | | | | | CONFIGURATION: Two 230 Gal. Tip Tanks GROSS WEIGHT: 12,100 Lb. | | | |
|---|---|---|---|---|---|---|---|---|
| % Rpm | N. MI/Gal | Mach No. | CAS (Kts) | PRESSURE ALTITUDE (FEET) | CAS (Kts) | Mach No. | N. MI/Gal | % Rpm |
| 84 | .634 | .46 | 304 | SEA LEVEL | 275 | .42 | .673 | 79 |
| 85 | .733 | .48 | 291 | 5,000 | 265 | .44 | .788 | 80 |
| 86 | .857 | .51 | 281 | 10,000 | 254 | .46 | .930 | 81 |
| 87 | 1.009 | .53 | 265 | 15,000 | 246 | .49 | 1.090 | 83 |
| 90 | 1.134 | .58 | 264 | 20,000 | 235 | .52 | 1.256 | 85 |
| 91 | 1.281 | .59 | 248 | 25,000 | 228 | .54 | 1.427 | 87 |
| 93 | 1.442 | .64 | 239 | 30,000 | 222 | .60 | 1.625 | 89 |
| 96 | 1.548 | .68 | 227 | 35,000 | 209 | .63 | 1.832 | 91 |
| | | | | 40,000 | | | | |
| | | | | 45,000 | | | | |
| | | | | 50,000 | | | | |

a little interpolation may be necessary. From this point the flight planning procedure is the same as that previously explained for computing groundspeed, drift correction angle and the distance flown during the climb.

The big problem is putting the finger on the guy in the outfit who's going to make up the chart. If there's a man with a head full of figures—numerals, that is—he's a good bet. But watch him pretty closely. Things get a little binding about the 35,000-foot level.

### Other Factors

There are a few other points that should be kept in mind when working with climb computations. Remember, altitude is expressed in "pressure altitude feet." This means that the data on the chart are based on pressure altitudes and that pressure altitude variation should be considered.

If not computed, a very small error will result; however, if the pressure altitude variation is 600 feet or greater, it should be computed. This means that the corrected rate of climb, fuel and distance must be computed for 600 feet of climb, using the corrected set level rate of climb before computing the data for the first 5000 feet of climb.

Another factor that must be considered in computing climb data is the altitude of the field from which the flight is to be made. When taking off from an airfield at an altitude other than zero feet, you must adjust the climb data to compensate for this difference. For example, assume the flight is to originate from Lowry AFB, where the field elevation is 5420 feet. Obviously the first 5000-foot increment to be computed will be the level from 5000 to 10,000 feet, but it is necessary to subtract the time, fuel and distance that would be necessary to climb 420 feet.

During the climb, the airspeed should be changed smoothly and gradually. For instance, the climb from sea level is started at 275 knots CAS and is gradually changed so that, as the aircraft passes through the 5000-foot level, the airspeed is 265 knots CAS. The airspeed is changed throughout the climb in this manner.

### Flight En Route

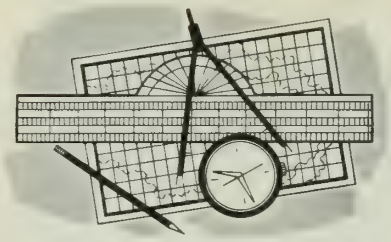
En route flight planning is the planning of that portion of the flight at cruising altitude from the point of level-off until the aircraft is over the destination or to the point at which the descent is begun, whichever is sooner.

Normally, the best altitude at which to cruise will be one which gives the best cruising range when the wind, fuel consumption and true airspeed factors are considered. To explain the factors involved in determining best cruising altitude, let's look at the following example:

Assume the data computed for the climb indicated that a T-33 aircraft would have 500 gallons of fuel remaining on reaching 35,000 feet. Also, assume a tailwind of 80 knots at 35,000 feet and a tailwind of 40 knots at 40,000 feet, with standard day temperatures at both altitudes.

At first, it appears that 35,000 feet would be the best cruising altitude. However, the final selection of the cruising altitude must be made by reference to the Flight Operating Instruction Chart in the Tech Order for the aircraft.

On this chart we find that the best cruising power setting for an 80-knot tailwind at 35,000 feet gives



power setting with a 40-knot tailwind at 40,000 feet gives a range factor of 1.1 with a groundspeed of 427 knots. By referring to the data opposite the 500 - gallon fuel level under the 35,000-foot column on the chart, you find that under a no wind condition, the maximum range of the aircraft is 871 nautical miles by remaining at 35,000 feet; however, climbing to 40,000 feet with the same wind condition increases the maximum range to 964 nautical miles. The maximum range with an 80 knot tailwind at 35,000 feet is found by multiplying the maximum range under a no wind condition, 871 nautical miles, by the range factor (1.2); 871x1.2= 1045 nautical miles maximum range.

Computing the maximum range for a 40 knot tailwind at 40,000 feet in a like manner you find it to be 1060 nautical miles (964 x 1.1 = 1060). Therefore, it can be seen that the maximum range is increased by 15 nautical miles by climbing to a cruising altitude of 40,000 feet with the above wind conditions.

The Flight Operating Instruction Chart provides for the descent to sea level and landing with a fuel reserve of 50 gallons. The chart for the specific engine model used in the aircraft should be used and the chart should be checked closely to determine whether or not an allowance was made for reserve fuel on landing.

The best power setting to produce the greatest range for the wind condition and altitude is shown on the Flight Operating Instruction Chart as is the CAS and groundspeed to be expected from the power setting. It should be noted that the indicated airspeed is normally higher than the CAS as is indicated on the Airspeed Correction Table in the Technical Order for the aircraft.

### Fuel Weight

At the beginning of the flight, the CAS will normally be lower than shown on the chart for the power setting because of the weight of the fuel. As the gross weight of the aircraft diminishes with the use of fuel, the airspeed increases, until near the end of the flight the airspeed will be higher than that shown for the power setting.

The altitudes on the Flight Operating Instruction Chart for computed fuel consumption, calibrated airspeed and groundspeed are for a standard day on which pressure altitude, indicated altitude and density altitude are one and the same. Aircraft performance is based on density altitude, therefore the pilot must determine and fly the indicated altitude necessary to make good the selected density altitude. This is accomplished on the E6B computer, as follows:

Assume the density altitude of 30,000 feet has been selected as the desired cruising altitude and that a temperature of -25°C. is shown on the adiabatic chart at 30,000 feet. On the altitude compensation scale of the computer, set -25°C. opposite 30,000 feet. Then, opposite 30 on the outer scale (miles scale) read the indicated altitude (27,700) to be flown to make good a density altitude of 30,000 feet. Therefore, an indicated altitude of 27,700 feet must be maintained in order that the en route cruise control computations for a density altitude of 30,000 feet will be correct, and the climb data should be adjusted to compensate for the difference in climb.

The en route groundspeed and drift correction angle is determined on the E6B computer by applying the forecast wind direction and velocity to the true airspeed. In-flight ETA's

## Jet Letdowns

The primary purpose in the establishment of the jet letdowns was to permit jet aircraft to accomplish penetration and standard instrument approaches with the least possible delay in time and the minimum number of turns.

These jet penetration procedures are established so as to provide the least interference with conventional type aircraft, and to provide for the accomplishment of jet letdowns when conventional aircraft are held on the primary fix where the jet aircraft is executing letdown. In almost all cases the low cone altitude and the procedure turn altitude published in the jet instrument procedure are identical to the standard range approach.

★ *Initial penetration altitude.* The altitude at which aircraft crosses radio facility for beginning penetration procedures. This altitude will be established for each procedure and will normally be specified as 20,000 ft MSL.

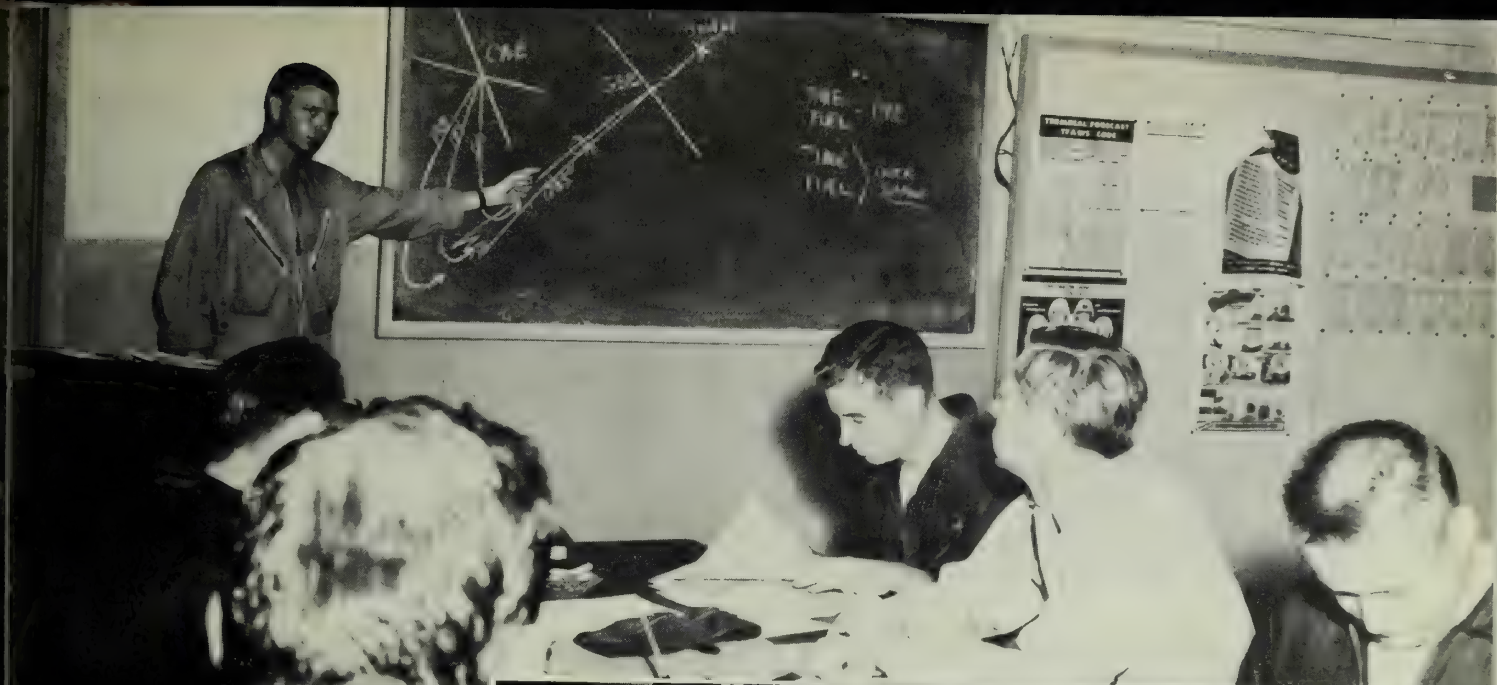
★ *Penetration turn.* A one and one-half degree per second turn is made during the jet penetration procedure to return the aircraft to an inbound heading to the radio facility being used for the penetration. The penetration turn is normally a flat turn, however, if a descending turn is used, indication will be given in the procedure.

★ *Minimum penetration altitude.* The minimum altitude for the jet penetration procedure turn to an airport will be the initial approach altitude for the standard instrument approach procedure.

★ *Initial approach altitude.* The initial approach altitude will normally be as shown for the standard instrument approach procedure. Where no initial approach altitudes have been established, a clearance of at least 1,000 feet above all obstructions within a radius of ten miles of the radio facility and ten miles to either side of all penetration courses within an open quadrant for a distance of 40 miles from the radio facility must be provided except in mountainous areas. In all parts of the United States and Canada designated as mountainous areas a clearance of at least 2000 feet must be provided.

★ *Procedure turn.* Will be executed as shown in the standard instrument letdown criteria.

★ *Emergency altitude.* An altitude which will clear all obstructions within a radius of 100 nautical miles of the radio facility by 1000 feet except in mountainous areas. In mountainous areas the clearance will be 2000 feet.



Briefings for formation or student flights should cover every phase from runway length to final approaches.

between fixes should be based on the groundspeed computed during the preflight planning and not recomputed because of an apparent error between two fixes. At high altitudes the azimuth indicator of the radio compass fluctuates and does not give an instantaneous indication of station passage and, when flying radio range signals, the cone of silence is of such width that there may be an error of one to three minutes in determining station passage. At a groundspeed of 478 knots with check points 174 nautical miles apart, an error in time of this size would mean an apparent error in groundspeed of 56 knots. Hence, the same method of determining station passage should be used for all check points, i.e., if the movement of the azimuth indicator through the 90 or 270-degree point is used for the time of station passage over the radio aid, it should be used in the same manner over subsequent radio aids. In general, through experience, it has been found that the groundspeed computed for cruising altitude during the preflight planning should be used in flight for determining all ETA's.

Constant pressure and temperature levels vary in actual height above sea level. Since the true altitude for a given indicated altitude changes with any changes in temperature or pressure, the aircraft will climb or descend while a constant indicated altitude is being maintained. These climbs or descents may cause the indicated airspeed to change by as much as eight knots.

In order to attain maximum efficiency from an aircraft that derives some engine efficiency from a ram intake, climb above the cruising altitude (200 to 300 feet for the T-33), then descend at approximately 200 fpm to the desired altitude, allowing the indicated airspeed to build up to or above that desired for cruising before reducing the power from the climbing power setting. Fly the aircraft smoothly and maintain the desired altitude as nearly constant as possible.

## DESCENT CHART

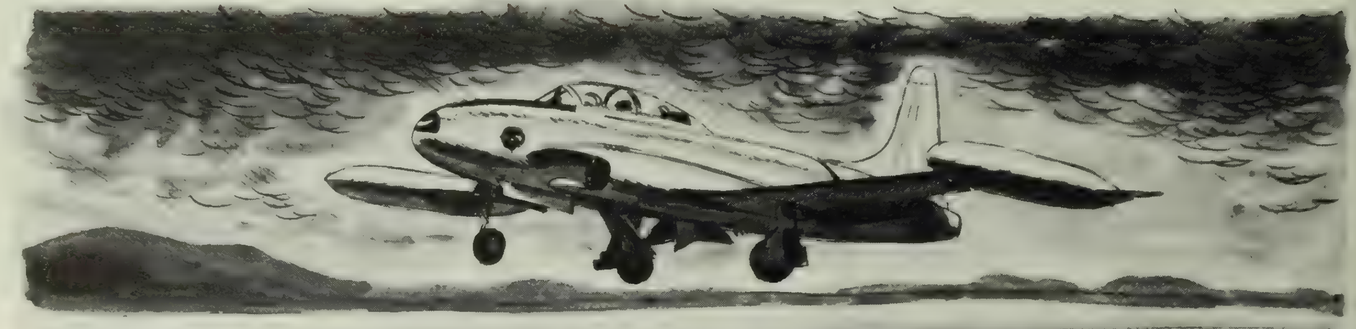
NACA STANDARD DAY

Airplane Model(s)
T-33A

Engine Model(s)
J33-A-23 or -35

CONFIGURATION: Two 230 Gal. Tip Tanks
GROSS WEIGHT: 10,600

| RATE OF DESCENT | APPROXIMATE TO SEA LEVEL Dist. N.M. | Time | Fuel | CAS (Knots) | PRESSURE ALTITUDE FEET |
|---|---|---|---|---|---|
| 1150 | 74.5 | 12.4 | 23 | 174 | 40,000 |
| 1750 | 54.5 | 8.9 | 18 | 200 | 35,000 |
| 2400 | 40 | 6.4 | 14 | 226 | 30,000 |
| 3200 | 29.5 | 4.7 | 10 | 248 | 25,000 |
| 4100 | 20.8 | 3.4 | 8 | 274 | 20,000 |
| 5150 | 13.9 | 2.2 | 5 | 305 | 15,000 |
| 6300 | 8.7 | 1.4 | 3 | 335 | 10,000 |
| 7600 | 4.3 | 0.6 | 1 | 365 | 5,000 |
| 9000 | 0 | 0 | 0 | 395 | Sea Level |



# PENETRATION & LOW APPROACH

JUDGMENT is a word that comes in two sizes — good and bad. Pilots have been exercising both sizes in airplanes for a half century.

Until the arrival of jets on the aviation scene, only a certain few types of flights really taxed a pilot's ability to analyze a flight situation and exercise the proper judgment to take himself and his aircraft through the situation successfully.

With jets the frequency of situations demanding good judgment is stepped up considerably. The climb, cruise and the descent all present peculiar problems calling for sound judgment in any jet flight.

The greatest of these three is the descent. For the success or failure of many jet flights will depend solely on the judgment exercised in planning a descent from cruising altitude, whether conditions are VFR or IFR.

The Descent Chart in the pilot's Flight Operating Instructions (see Fig. 3) contains the data necessary to plan a descent with the most favorable range-fuel ratio for your particular aircraft. The chart indicates the distance from destination at which a descent should be started, under a no-wind condition. It also shows the proper airspeeds to be used and the fuel which will be consumed in the descent, together with prescribed rates of descent. The data on the chart are based on a standard day with the power set at idle and the aircraft "clean," unless otherwise stated. The chart shown in the illustration contains data applicable to the T-33 aircraft.

To illustrate the use of the chart, assume a cruising altitude of 35,000 feet on a standard day in a T-33. With the throttle in idle and the aircraft "clean," the initial rate of descent will be 1750 fpm at 200 knots (CAS). The letdown should be started 54.5 nautical miles from a destination with a sea level elevation.

The time required for the descent will be 8.9 minutes and the fuel used will be 18 gallons. The rate of descent and CAS are increased with the loss of altitude as shown on the chart, and these changes should be constant and smooth throughout the descent.

### IFR Technique

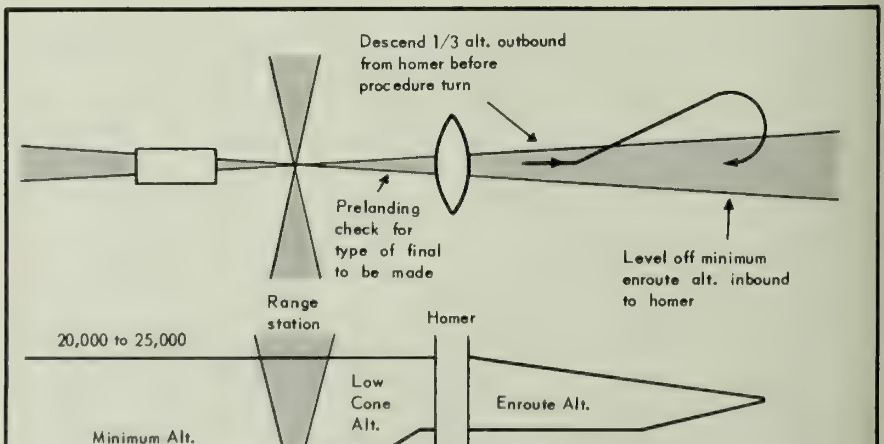
The Descent Chart just about whips the problem in a VFR descent. However, if the destination is IFR, other factors must be considered in planning a descent at destination. If the destination is IFR, a plan must be made for a penetration that is safe, expeditious, positive, can be controlled by the appropriate control agency and which places the aircraft in the most advantageous position to make the type of low approach contemplated.

Experience has proven that it is very poor judgment to descend below 20,000 feet en route to a destination that is IFR, even if an expedited approach is assured. For example:

A jet reports over the fix at 10,000 feet. The pilot is advised to hold because ARTC has an aircraft at a lower altitude in the vicinity that has not reported over a designated fix, or Approach Control has cleared an aircraft to take off and the pilot of the departing aircraft has forgotten to report passing a designated fix. As a result, the incoming jet pilot must declare an emergency and descend through altitudes without positive separation. Another illustration: A severe rainstorm has moved over the field and GCA cannot pick up the jet fighter, which has approximately 1/6th the reflecting area of the F-51. The ceiling and visibility are too low for a range approach and the jet, at 10,000 feet, does not have sufficient fuel to climb out and go to the alternate. The result is obvious.

If, however, the pilot remains at a minimum of 20,000 feet until reach-

Fig. 1


Descend 1/3 alt. outbound from homer before procedure turn
Prelanding check for type of final to be made
Level off minimum enroute alt. inbound to homer
Range station
Homer
20,000 to 25,000
Low Cone Alt.
Enroute Alt.
Minimum Alt.

ing the fix and receiving clearance, he is then in a position to make an approach within his capabilities or to proceed to an alternate.

Twenty to twenty-five thousand feet is a good altitude range in which to report over your destination fix. From this altitude your time for penetration is not excessive and you have altitude working for you in the event you must proceed to an alternate. If cruising at altitudes higher than these, use the Descent Chart in planning a descent to arrive over the fix at the desired altitude. By subtracting the figures opposite the new desired altitude on the chart from those opposite the cruising altitude, you can determine the fuel, time and distance for the descent.

For example, a T-33 aircraft cruising at 40,000 feet is cleared to cross the destination fix at 20,000 feet. Under a no wind condition, the chart indicates that the descent should be started 53.7 nautical miles from the fix; the descent will take 9.0 minutes, and 15 gallons of fuel will be consumed.

When the fix is reached, there are several methods of making a penetration, depending upon traffic conditions, terrain, fixes and approach aids available. It's a good practice to simulate penetrations in VFR weather from altitudes between 20,000 and 25,000 feet to determine (1) the amount of fuel consumed during the penetration and low approach, (2) the total elapsed time for the descent and approach and (3) the ground pattern covered by the aircraft while making various types of penetrations.

There are many types of penetrations that can be successfully accomplished. Some of the various penetration and low approach procedures are described and illustrated on the following pages. Although the airspeeds, power settings and techniques are those specifically applicable to the T-33, corresponding airspeeds in knots can be used in other jet fighters.

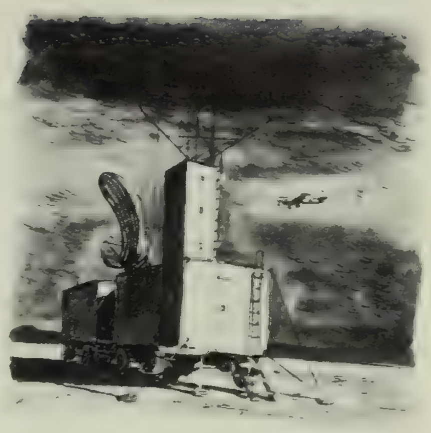
## Types of Approaches

★ *Approach Using a Homing Facility on the Approach Bearing:* (Fig. #1.)

This type penetration and approach is ideal for jets when the homing facility is located on the approach leg of the range so that the low cone altitude provides terrain clearance for an aircraft descending inbound from the homing facility to the low cone.

The penetration is made from the homing facility, on the reciprocal of the approach bearing. Lose one-half the altitude before starting the procedure turn. Any airspeed, gear, flap and power combination can be used during the penetration, but the indicated airspeed must be held constant and the rate of descent must not be permitted to decrease. The aircraft must remain within reception distance of the radio aid and sufficient power must be used (1) so that the pilot will get a reasonable amount of acceleration from the engine if needed and (2) so that sufficient heat for the defrosters and anti-icers will be assured.

The recommended conditions for the F-80C or T-33 are 152 knots TAS, full flaps, dive brakes, gear down and 65 per cent power.



After the procedure turn is completed, the level off is started 1000 feet (2000 feet in formation) above the minimum en route altitude for the range leg. The level off is accomplished by retracting the wing flaps completely without hesitation, raising the landing gear, and when 200 feet above the desired altitude, retracting the dive brakes. Research has shown that this is also the most satisfactory sequence for instrument level-offs. The aircraft then proceeds to the homing facility at the minimum en route altitude at a power setting of 65 per cent. When over the fix, make the pre-landing check in preparation for the final approach, whether it be GCA, ILAS, radio range or a combination of these approaches.

If for any reason the aircraft (T-33) should have to hold at a low altitude, the power should be adjusted to maintain a fuel pressure of 60 psi. Sixty psi fuel pressure usually can be held at 65 per cent rpm and

Fig. II

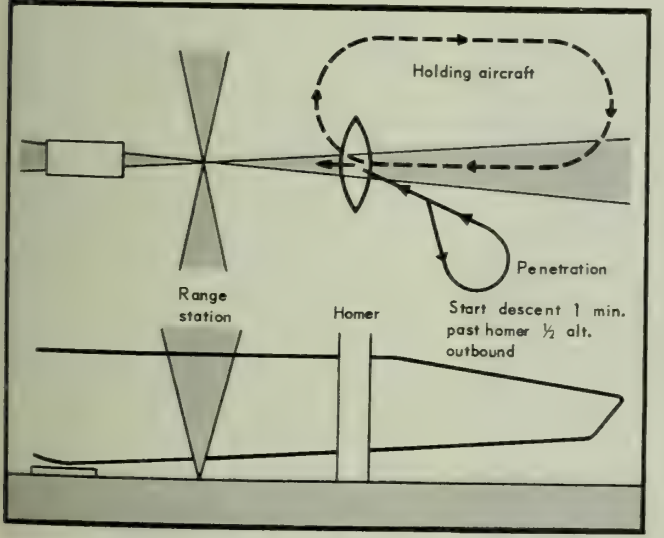
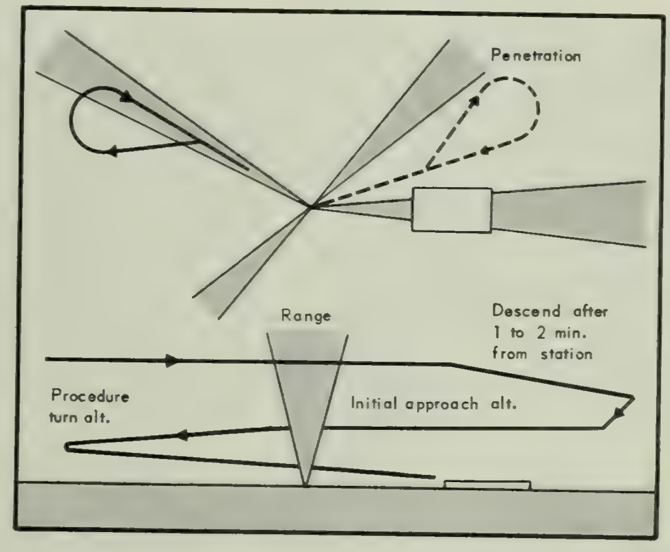
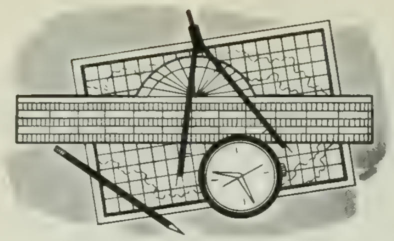


Fig. III





a fuel consumption rate of approximately four gallons per minute results. Sixty-five per cent rpm is sufficient power to maintain airspeed and altitude in a turn using up to a 30-degree angle of bank with a fuel load of 200 gallons or less.

If a GCA or ILAS approach is used, lower gear, dive brakes and 35 to 60 per cent wing flaps on final approach and reduce the indicated airspeed to 130 knots. Add five knots per hour to the above airspeeds for each 100 gallons of fuel remaining in excess of 200 gallons. Descend to the altitude which will intercept the glidepath at the proper point. Then adjust the power to maintain altitude and airspeed. The amount of fuel used in this type penetration and low approach for the T-33 is 65 to 70 gallons.

★ *Straight-In Approach*

If a straight-in range approach is made, lower the gear after passing the fix inbound, descend to low cone altitude holding 174 knots. Upon reaching the low cone altitude, level off, permit the airspeed to drop off to 139 knots, then add power to 74 per cent to maintain this airspeed. The total fuel used in this type penetration and low approach from 20,000 feet in the T-33 is 60 to 65 gallons and the total time for the approach should be between 10 and 14 minutes.

★ *Approach Using Radio Range Only (No Lower Traffic).*

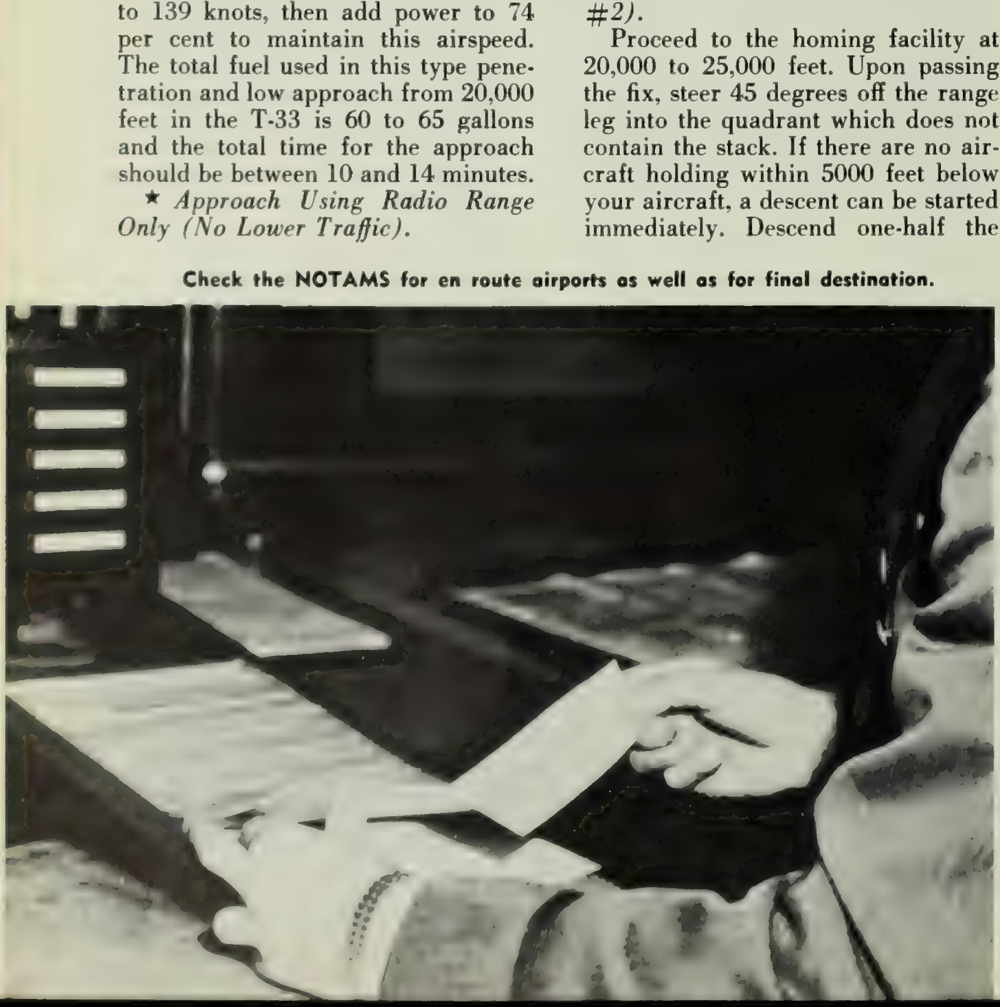
Cross the radio range station at 20,000 to 25,000. Proceed out the range leg opposite the procedure turn leg. Lose one-half the altitude outbound as previously outlined. Return to the range station at the en route altitude of the leg you have just flown or at the procedure turn altitude, whichever is higher. Upon crossing the range station, execute a normal range approach as published for that station. Proceed from the station out the procedure turn leg not over one minute and thirty seconds at approximately 174 knots (65 per cent in T-33) and descend to procedure turn altitude with dive brakes down.

Upon reaching procedure turn altitude, raise dive brakes. Execute the procedure turn, and when on course inbound, lower the gear, hold 174 knots and descend to low cone altitude. At low cone altitude, level off and permit the airspeed to drop to 139 knots, then add power to about 74 per cent to maintain 139 knots. Use dive brakes to descend from low cone altitude to minimum altitude, retracting them after reaching that altitude. This approach will take 60 to 68 gallons of fuel and 15 to 17 minutes total time. It can be made with a formation.

★ *Approach in an Open Quadrant Using Homing Facility (With Traffic Holding at the Homing Facility, Fig. #2).*

Proceed to the homing facility at 20,000 to 25,000 feet. Upon passing the fix, steer 45 degrees off the range leg into the quadrant which does not contain the stack. If there are no aircraft holding within 5000 feet below your aircraft, a descent can be started immediately. Descend one-half the altitude outbound as described above, continue descending in the procedure turn, return to the homing facility at the assigned altitude and make an approach straight in, GCA, ILAS or radio range.

**Check the NOTAMS for en route airports as well as for final destination.**



If the aircraft are within 5000 feet below you, proceed out into the quadrant one minute or more before descending. Then proceed as above. This type of penetration and approach takes 60 to 70 gallons of fuel and approximately 14 to 15 minutes.

★ *Aproach With Traffic On All Legs of the Range and No Homing Facility Available (Fig. #3.)*

In the event through traffic, holding traffic, etc., have all legs of the radio range occupied, proceed as follows: Cross the range station at 20,000 to 25,000 feet and proceed outbound (terrain permitting) on the bisector heading of either of the quadrants which has the landing field located on the range leg separating them.

To avoid descending through occupied altitudes on the range leg, level flight is maintained on the outbound bisector heading until clear of the range leg and/or the airway, normally one or two minutes depending on groundspeed. The penetration is made as described above for the radio range approach except, instead of descending on the range leg, the penetration is made in an open quadrant. Return to the range station at an assigned altitude from which a normal range approach, GCA or ILAS can be made. Eighty to ninety gallons of fuel will be consumed and the approach will take 16 to 18 minutes total time.

If a GCA is made using a rectangular pattern after returning to the range station, approximately 110 gallons of fuel will be consumed and 18 to 23 minutes required for the complete letdown from 20,000 feet to touchdown. It's a good idea to request GCA to pick you up inbound upon completion of the procedure turn for a straight-in GCA. With proper planning, a track can be flown from the range station to get in position for a straight-in GCA approach.

These are only a few of the basic types of jet approaches that are available to a pilot in the event a letdown is necessary. As you can see, no one type of penetration fits every situation. Judgment, once again, determines your choice of method.

The old, old method of "Ready or not, here I come" just doesn't fill the bill for jet IFR letdowns. ●

# GOING DIRECT?

# . . . fly one heading!

### By Capt. John C. Neill

DID you ever hear of a Geostrophic Wind Scale? If you have, the Air Weather Service is looking for you if they haven't already found you. Furthermore, if you have — forget it 'cause I don't know what it is and probably couldn't explain if I did. Don't stop reading now! I go under the theory that if a guy talks long enough, he is bound to say something sooner or later.

You know, I used to think weather forecasters were all a bunch of pessimistic die-hards. They just draw a bunch of red, blue and purple lines all over maps and talk about mixing ratios, isogonic and isothermic lines just to impress or confuse you. I don't let that bother me, no sir-eee! I just pull out that green card when I start toward the Ouija — I mean weather office. Boy, that thing gives you about as much prestige in a weather office as it does in a good hailstorm.

Well, the other day while I was waiting to get some jet-juice, I decided to stroll through and see what evil winds they had brewed between Moody and Chicago. Would you believe it: one of those astrolog--I mean forecasters, had the nerve to ask if he could help me, and all the time I had that green ticket in plain view. Of course I looked around to see if any of my friends were watching before I answered him. You don't think I want to be a disgrace to the Clan of the Green, do you?

## Ready To Go

Finally, I told him that I was just about ready to saddle a hot pipe for the Windy City and wondered what kind of breeze was blowing around 40,000. Naturally, he went over to the winds aloft charts, but they were blank, as usual. Immediately, I put on my best ironic smile and was about to tell him that it really didn't matter when he walked over to another chart and motioned me to follow. That suited me fine: "The more rope you give him, the higher he will hang himself."

He took the chart off the board and placed it on top of a table. Now this was OK by me, but then he started getting personal. He asked me what altitude, route and airspeed I was going to fly. I guess I should have turned all eight loose on him at once but I managed to control myself. I finally calmed down enough to tell him in a rather cryptic tone that I was going at 420 knots TAS, 40,000 feet and direct Montgomery, direct Chicago — anybody knows a jet jockey goes direct and does not bother with airways or ADIZ zones.

By the time I had lit a cigarette, blown a couple of smoke rings, and turned to see what he had done with the chart, he started giving me the word just like he knew what it was like flying a "squirt job" at 40,000. He told me to climb on course and fly directly over Maxwell Radio. From Maxwell Radio, he told me to hold 17 degrees of left drift correction and it would put me over O'Hare Airport at Chicago.

Now I know that putting out this kind of info isn't SOP with forecasters, but this man seemed anxious to prove something to me, so I decided to go along with the gag.

I started a fire in the flues and pointing its nose down the runway, I gave throttle. It did not seem like any time had passed before I was at 40,000 and turning over Maxwell. Now the heading from Maxwell to Chicago is about 353 degrees so I held 336 just like the man said.

I knew that I was supposed to go just to the left of Nashville, and just to the right of Terre Haute. Well, I was to the left of Nashville but when I reached Terre Haute, I went to the left of it. When this happened, I knew I had one each weather forecaster dead to rights; however, I decided that I would continue and get a good case against him. You know what? I should have quit while I was ahead. When I turned the "Bird Dog" to the homing beacon located at the outer marker at O'Hare, the needle pointed off to the right about three degrees. About two minutes before I crossed the facility, that needle had moved over until it was pointing straight ahead, i.e., I passed over the station just like he said I would.

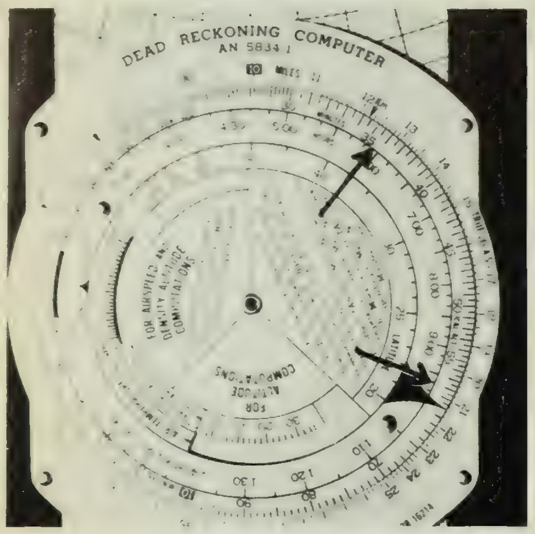


Fig. 1: Here is an E6D setup to get crosswind component of 126 knots.

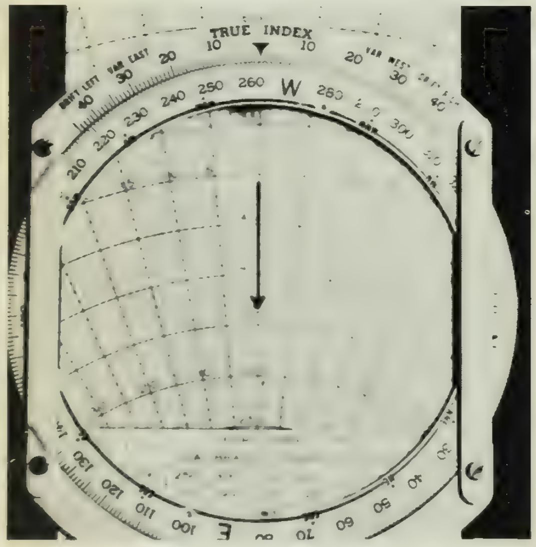


Fig. 2: This is the way you convert the crosswind to obtain the drift angle.

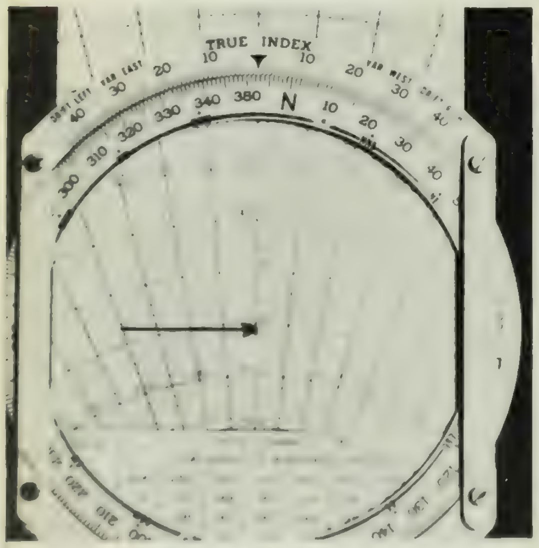


Fig. 3: Now you read the single drift angle at the tip of the wind vector.

### Quite a Blow

Believe me, that was quite a blow to morale and it started me to thinking. The weather officer had computed my drift for me so quickly that I had missed the entire operation while lighting a cigarette. Maybe he had something which might even be useful to a "red-faced" jet pilot. At least, it would not hurt to ask about his system.

I did just that when I returned and what I found out was startling! In the first place, I found out that the weather man who had figured out my drift correction was a full-fledged jet pilot as well as a weather officer. Furthermore, he did a tour of combat with the 51st Fighter Group in the Korean fracas. At the same time, he was flying weather reconnaissance and forecasting where they were playing for keeps. He happened to be Major Leon M. Grisham, and was now Assistant Director of Academics, 3550th Training Group, Moody AFB, Georgia. This group consists of the USAF Instrument Pilot School; the Instrument Phase, USAF Aircrew School (Interceptor), and the Jet Transition School.

While I was trying to figure out whether he was a jet jockey that had slipped or a weather man that had been upgraded, he was explaining how he had computed my drift correction — in fact, he explained the process before I knew what was going on. As a result, he had to explain it again! Well, the thing was so simple that I had a hard time understanding it. Nevertheless, I am going to try to tell you how it is done, so here goes!

Somewhere during your checkered career you've probably heard rumor of a relation between windspeed and pressure. Well, it's true. Give a crystal ball gazer several pressure readings and he'll slap them into that "Geostrophic Wind Equation" that we glossed over but lightly at the beginning of this thing and out comes the windspeed.

OK — so you're convinced. But did you know that you too can diddle with this "Geostrophic Wind" thing? The AN 5834-1 Dead Reckoning Computer (E-6D to you) has a scale based on this formula.

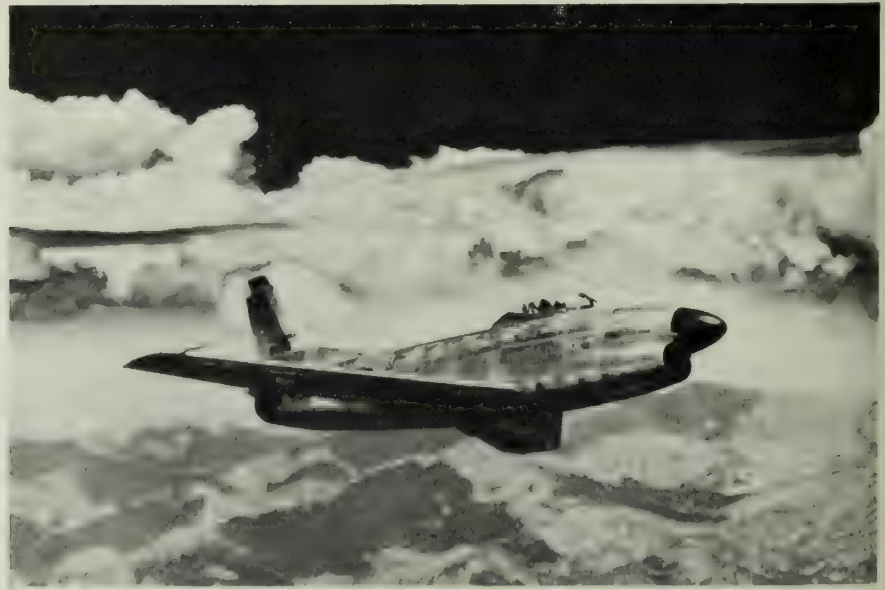
### How It Works

Here's how it works. Once you have decided where you are going and at what altitude, ask the forecaster for the height of the pressure surface at your flight altitude over the point where you will reach altitude and over destination. Give him a rough guess at the times you expect to be over these two points, and he can crank out some pretty accurate figures. Then you can compute the difference in height (subtract one from another, sorehead) and set up the problem on the E-6D thusly:

On the computer face, set difference in pressure height — on the miles scale over distance in nautical miles — on the minutes scale between the two points.

Now, chase around the computer until you find a scale marked latitude. Find it? OK — read out from

"The weather officer had computed my drift for me quickly and accurately."



"You get there fustest with the mostest because pressure pattern flying saves you both time and valuable fuel."

the average latitude of your flight to find the crosswind on the miles scale.

That's it. That's all there is! You now have crosswind in knots. Slap it on your computer at 90 degrees to your true course, turn the compass rose 90°, put the tip of the wind arrow on your true airspeed by moving the slide upward, and read off the drift angle — the one, single drift angle for the entire flight at altitude.

For the hotter stove pipe drivers who are completely buffaloed by the wind face side of a computer, we have an even simpler method to arrive at this single drift angle. Just place your TAS in knots (minutes scale) opposite your crosswind velocity in knots (miles scale). The black rate arrow points to your single drift angle. If you don't believe it, then try it.

Don't run away until I give you a few ifs, ands and buts.

★ It is accurate only for that portion of your flight at cruising altitudes.

★ You have computed a net motion of the air mass perpendicular to your flight path — that means you have crosswind only and crosswind can never be used to get ground speed.

How about running through that sample flight? We flew from Moody AFB to Chicago by way of Maxwell. Flight altitude 38,000 feet and TAS roughly 420 statute. We were at 38,000 feet prior to reaching Maxwell, so we will compute our single drift from Maxwell to Chicago. The first thing we do is ask the weather people for the heights of the pressure level over Maxwell and Chicago at the approximate arrival times. The forecaster gives us 39,420 and 37,360 feet MSL, respectively. To find the difference in height, we subtract algebraically departure from destination (Maxwell height from Chicago height), which gives us 2060 feet. This being a negative value means drift correction will be left. If it were a positive value, drift correction would be right.

Our basic flight planning consists of obtaining Flight Charts #187 and #229 and drawing a straight line on them from Moody to Maxwell, then another straight line from Maxwell to O'Hare. To get data for our flight between Maxwell and O'Hare (1) we measure the distance. 580 N. miles. (2) We carefully measure the true course at the midpoint, 353°, (3) we find the average magnetic variation, 3°E, and (4) finally we note the average latitude to be 37°.

Now what have we: TAS 420 MPH or 365 Knots ($D^2D^1$) Difference in height — 2060 feet, Difference in N. miles 580, Average Latitude 37°N. Drift Correction — Left, Average Variation — 3°E., True Course — 353°.

Now for the Computer: Place 2060 on the miles scale opposite 580 on the minutes scale. Opposite 37° on the latitude scale, we then read 126 on the miles scale. (See Fig. No. 1) This is the crosswind component: 126 Knots. All you have to do now is convert this crosswind to drift. Place the crosswind on the vector face from a direction of 90 degrees to the true course of 353 degrees (263°). (Fig. 2) Now rotate the compass rose 90° to the left (Back to 353°) and move the slide upward until the tip of the wind arrow is on your TAS of 365 Knots. Now you read your single drift angle at the tip of the wind vector to be 20 degrees (Fig. 3).

Another method to obtain this drift angle is to place your crosswind component of 126 knots on the miles scale opposite to your TAS, 365 Knots, on the minute scale and the black rate arrow points to your drift of 20 degrees.

$TC \pm W = TH \pm V = MH$

$353^\circ - 20^\circ = 333^\circ - 3^\circ = 330^\circ$

That's the story. Over Maxwell, turn on course to Chicago, crank in —20 degrees drift correction and hold it until you split the cone at Chicago. You'll save time and fuel because what you are actually doing is flying a pressure pattern.

If you use single drift corrections to obtain single magnetic heading flights, there are three precautions to be observed: (1) if the difference in the magnetic variation at the beginning and end of your course is more than six degrees, the flight should be broken down into several magnetic headings to prevent you from getting too far from the pressure pattern flight path you have calculated (this is especially true on East-West flights), (2) you should get the weather forecaster to give you an accurate forecast on your effective headwinds or tailwinds so you can estimate your groundspeed (check this during flight) and (3) your Slave gyro MUST be accurate. ●

# EJECTION PROCEDURES

F-94-C

F-86-D

### LOCKHEED

**F-80* B-C**

1. Jettison canopy by raising jettison handle located in lower right side panel (with manual canopy, crack open 2" before jettisoning.)

2. Raise both armrests into latched position. (Left locks harness.)

3. Squeeze trigger on right armrest to jettison seat.

*There is no provision for seat ejection on F-80A aircraft.

**F-94 A-B**

1. Radar Operator raises radar console and lowers visor.

2. Blow canopy by pulling jettison handle located on right fuselage sill. (*Caution:* Do not raise right armrest on either seat before pulling canopy jettison handle, as this will make it impossible for the operator to move the jettison handle through its entire travel and prevent normal jettisoning. Furthermore, it is quite probable the canopy will not blow if unlocked prior to pulling jettison handle.)

3. R. O. must make an effort against strong airflow to assume recommended position for ejection.

4. Raise both armrests . . . right cocks trigger; left locks harness.

5. Squeeze trigger on right armrest. *Caution:* Don't hit seat trigger before or during canopy jettisoning as seat safety pin will bind and may not be extracted by canopy.

**F-94C**

In early models, ejection method is the same as in F-94A and B; however, in series AF 51-5567 and subsequent aircraft procedure varies:

1. After raising radar console, jettisoning canopy, etc., bring elbows in close to body and pull both hand grips to locked position. This will automatically raise armrests, cock trigger, lower seat and lock harness.

2. Before squeezing the trigger, be extremely careful to place both arms inside the armrests to assure clearance of cockpit sill during ejection. *Note:* On series AF 51-5627 and subsequent aircraft, ejection through canopy is possible by simply locking right armrest and squeezing trigger.

**T-33A**

1. Blow canopy by pulling jettison handle located on right fuselage sill. (*Caution:* Do not raise right armrest on either seat before pulling canopy jettison handle for this will make it impossible for the operator to move the jettison handle through its entire travel and the canopy will not blow. Furthermore, canopy may not jettison if unlocked prior to pulling jettison handle.)

2. Raise both armrests . . . right cocks trigger; left locks harness.

3. Squeeze trigger on right armrest. *Caution:* Don't hit seat trigger before or during canopy jettisoning as seat safety pin will bind and may not be extracted by canopy.

*Note:* On T-33A series AF-51-9035 and subsequent aircraft, ejection through canopy is possible by the following method:

1. If canopy fails to jettison, raise right hand grip—

2. Raise left hand grip to lock shoulder harness—

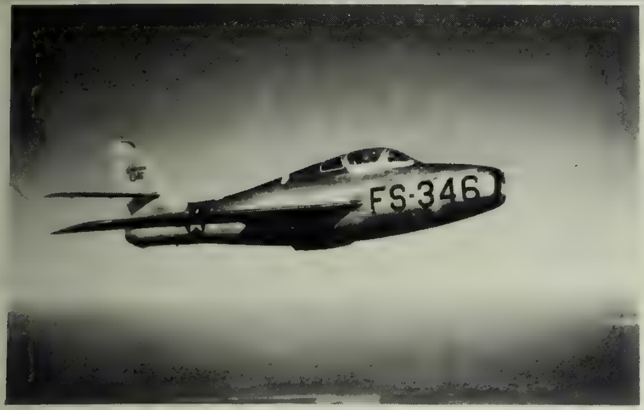
3. Squeeze trigger.

### REPUBLIC

**F-84 B-C-D**

1. Actuate canopy jettison toggle switch located on instrument panel. On F-84B and C only, crack canopy open about 2" before jettisoning. Canopy on D series should be fully closed.

**Although ejection procedures are essentially the same for all jet aircraft, ignorance of the variations in the systems of different models of an aircraft could spell disaster.**



F-84-F

F-89-D

| | |
|---|---|
| | 2. Raise left hand grip to lock harness.<br>3. Squeeze trigger. |
| **F-84 E-F-G** | 1. Pull up right hand grip to jettison canopy.<br>2. Pull left hand grip to lock inertia reel.<br>3. Squeeze trigger using the canopy jettison handle as a support.<br>*Caution:* Canopy charges will fire upon actuation of jettison toggle or right hand grip regardless of the canopy or battery switch position. Canopy jettisoning in F-84D, E, F and G series may not be effectual, however, unless canopy is fully closed. |

**NORTH AMERICAN**

| | |
|---|---|
| **F-86 A-E-F** | 1. Raise right hand grip to jettison canopy.<br>2. Raise left hand grip to lock shoulder harness.<br>3. Squeeze trigger.<br>*Note:* On F-86E-15, series AF-51-13046 through 51-13096, F-86F-20 series AF 51-13130 through 51-13169, F-86F-25 and subsequent aircraft, ejection through canopy is possible by the following method:<br>1. Raise right hand grip.<br>2. If canopy fails to jettison, raise left hand grip. This will lock shoulder harness and prepare seat to fire through the canopy.<br>3. Squeeze right trigger.<br>*Caution:* Left hand grip cannot be actuated until right grip has been raised to full up position. |
| **F-86D** | Ejection procedures are the same as on F-86F, with the following exceptions:<br>1. There is no provision for ejection through canopy.<br>2. On F-86D-40 and subsequent aircraft, raise either armrest to jettison canopy and squeeze either trigger to eject. |

**NORTHROP**

| | |
|---|---|
| **F-89 A-B-C-D** | 1. Raise left armrest. Canopy jettisons, radar scope dumps into stowed position, shoulder harness locks and hand grip separates from trigger.<br>2. Rotate right hand grip up to its locked position. Pilot's seat is lowered into ejection position.<br>*Caution:* Keep feet forward as seat lowers. Don't accidentally hit the ejection trigger.<br>3. Place feet as far back as possible and squeeze trigger. |

**10 Rules for Ejection**

- ★ Stow all loose equipment.
- ★ If at altitude, pull bailout bottle handle.
- ★ Disconnect all ties with the aircraft.
- ★ Disconnect oxygen hose clamp from harness to eliminate difficulty in leaving seat after ejection.
- ★ Lower P-3 helmet visor, fasten chin strap.
- ★ Keep head AS LOW AS POSSIBLE when jettisoning canopy.
- ★ After canopy has blown, sit erect, buttocks well back, chin in, head firm against headrest, feet tight in stirrups, arms locked in close . . . brace hard against the seat.
- ★ After ejection, release safety belt and shoulder harness and kick away from the seat.
- ★ Delay opening parachute if altitude permits. *Caution:* Don't pull ripcord until well away from seat.
- ★ If aircraft is in normal attitude and low altitude (2000') ejection is necessary, release seat belt and harness prior to ejection. Then kick away from seat fast.

*Note:* Ejection through the canopy is recommended only as a last possible means of escape in the event that the canopy will not jettison and a fatal crash is imminent.

# Engine Icing...

**To cope successfully with jet engine icing, a pilot should learn its causes, understand its symptoms and effects, and plan his flight accordingly.**

*We believe this article should be on each jet pilot's preferred reading list. It is a combination of several articles that have appeared in Flying Safety Magazine, revised and brought up to date by the Engineering Branch, Directorate of Flight Safety Research.*

★ ★ ★

THE greatest icing problem confronting the jet pilot is induction icing. But if he knows when to expect it, what to expect, and what to do about it, then there's no real problem—*for knowledge is the way to confidence.*

The problem of air inlet icing in turbo jet engines was recognized by the military services and the engine industry in the early stages of the jet engine development program. A considerable amount of laboratory testing had been accomplished as early as 1944, and icing flight tests were begun on a J-31 centrifugal compressor type engine mounted in the bomb bay of a B-24.

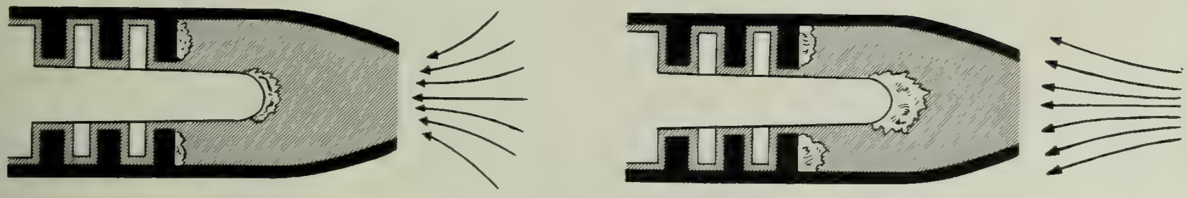
Such testing has been of a continuous nature ever since and the lessons learned should be of tremendous value to the jet pilot today.

As in all problems regarding ice on aircraft, i.e., ice on the wings, etc., certain atmospheric conditions must prevail at the time. The principal meteorological factors that contribute to jet engine icing are liquid-water content, air temperature and droplet size.

A definite amount of moisture content must be present in the air and the air temperature must be within a given temperature range.

Icing conditions are most prevalent when the outside air temperature is between a minus 10 degrees C. and a plus 5 degrees C., and the liquid water content ranges between 0.1 and

## Airspeed vs. Icing



Diagrams show effect of airspeed on icing. In general, when the velocity of the aircraft exactly equals the velocity of air into the duct, the stream lines are straight in and the moisture taken into the duct is exactly equal to the moisture in the atmosphere. When the airspeed is lower than the velocity of air into the duct, the engine is then sucking air. Air is accelerated into the air inlet and there is a tendency for droplets of air to be centrifuged out of the air exterior of the duct. The result is a lower water concentration than in the ambient atmosphere. When the velocity of the aircraft is faster than that of the air going into the duct, the result is spillage or slipstreams around the end of the duct. This has a tendency to centrifuge the moisture into the duct, resulting in a higher concentration of moisture than in the surrounding atmosphere.

1.0 grams per cubic meter. Under these temperature conditions, all ice-producing moisture conditions are not discernible to the pilot or crewmember.

Generally, when the moisture content in the air is relatively high, and the temperature is within the described limits, ice is deposited in appreciable quantity on any object passing through it. A high moisture content is required to deposit ice on the wings which will be visible to the pilot.

A moisture content too low for wing ice formation may still cause ice to form in the jet engine air inlet system, however. Atmospheric pressure conditions directly affect ice formation; so a review of meteorological instruction courses should be made for a complete basic understanding of ice-formation theories. It must be remembered that the outside air temperature is not the criterion for icing temperatures in the induction system. The limiting factor is the temperature within the induction system itself, and this temperature is dependent upon air pressure differential which results from the venturi effect of the system.

In the jet engine, the air is drawn into the induction system by the compressor, or rammed into it by the high speed of the aircraft in flight. Under either condition, the air in the induction system is cooled by the drop in atmospheric pressure taking place due to acceleration of the air by the compressor. Without an adequate temperature indicator in the induction system it is possible to produce ice in that system and not know it, when the outside air temperatures are slightly higher than the freezing point.

Potential ice development is most prevalent in the axial flow type jet engine. The centrifugal flow engine can develop ice on its screens but the probability of developing ice is very minute and is not considered a problem by the U. S. Air Force.

### Rate of Accretion

The rate of ice accretion in the jet engine induction system is dependent upon the amount of moisture in the air and quantity of air passing into the intake system. This, in turn, is dependent upon the turbine speed and the flight speed of the aircraft.

Unlike a reciprocating engine, the jet engine consumes large quantities of air in excess of that needed for combustion. This excess of air is needed to cool the hot sections of the engines. As ice forms, the total pressure at the compressor outlet is reduced. This loss in pressure results in decreased mass flow and consequently thrust, and is accompanied by an increase in turbine temperature. If the amount of fuel metered to the engine is not reduced, the temperatures in the hot section of the engine will rise until destruction of the engine may result.

It has been established by tests that ice formation in the induction system parts other than on the screens and inlet guide vanes has little effect on engine performance. However, the formation of ice on other component parts in the air-inlet area may, upon breaking off, damage the compressor section when passing into it.

Throughout the fall and winter seasons the atmospheric phenomena producing ice are going to be more prevalent than in warmer months because temperature conditions are more conducive to ice formation. However, it must be borne in mind that icing is possible in the summer months, as witnessed by the fact that eight F-84s crashed due to engine icing in July 1951.

Cold weather increases engine output performance, and as a result, loss of power from initial formation of ice may not be immediately discerned on a takeoff. When exhaust gas temperatures are normal, about 680°C, engine rpm 100%, ambient air temperature 0°C., the power output is 10% above standard maximum power. Consequently, a loss of power from the formation of at least 10% or more would have to be effected before it would ordinarily be detected.

As a precaution, engine rpm and exhaust gas temperature curves in the engine operating manuals should be consulted frequently for normal power output during winter months operations.

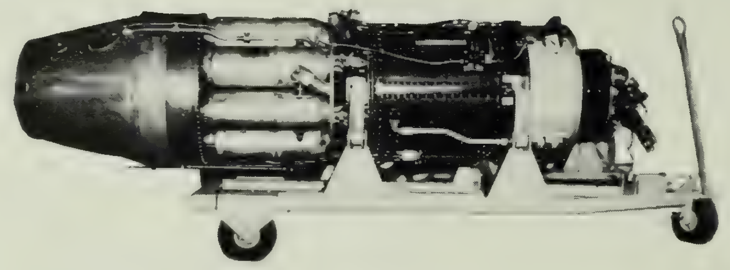
All jet pilots and jet maintenance personnel should be completely familiar with Technical Order 01-1-469. Although very brief, this T. O. gives a thorough rundown on jet engine icing problems and how they may be combatted.

As noted previously, one of the most important factors in cold weather flying is for the jet pilot to recognize icing conditions.

At the risk of appearing repetitious we feel it necessary to reiterate one of the better known phenomena that accompany jet inlet icing. Inlet duct icing can occur without the formation of ice on the external aircraft surfaces. Pilots should paste that bit of information somewhere in their mental "immediate action" file.

Remember, when a jet aircraft is flying at airspeeds below 250 knots and at high power settings, such as in a climb, the intake air experiences a pressure drop when passing through the inlet screens. The pressure drop causes a decrease of air temperature. Even if the outside air is at an ambient temperature above freezing, it may be reduced to sub-freezing temperature as it enters the engine. Net result: Ice!

Wing icing may be expected when the temperature is between -10°C. and 5°C. and the dewpoint is within 4°C. of the temperature. In this range lies the danger, as wing icing is most unlikely for visible warning. Note that we have stressed the dewpoint here. Remember the old tried and true rule of forecasting fog? If the spread between temperature and dewpoint is 4° or less, formation of visible moisture in the form of fog is most likely.



## ANTI-ICING FOR JET ENGINES

**The following table outlines the status of anti-icing provisions in jet engines.**

| ENGINE | AIRCRAFT | PROVISIONS |
|---|---|---|
| J47-GE-7 | F-86A | Not anti-iced, screens may be removed. |
| J44-GE-13 | F-86A, F-86E, B-45 | Not anti-iced in F-86s, screens may be removed. B-45s, some are anti-iced but have fixed screens. Screens may be removed. |
| J-47GE-9 and 15 | B-45 | Same as the J-47-GE-13 engine. |
| J47-GE-11 | B-47 | Not anti-iced, screens may be removed. |
| J-47-GE-19 | B-36E, D | Plans to anti-ice by retrofit, screens may be removed. |
| J47-GE-17 | F-86D | Anti-iced, retractable screens. |
| J47-GE-23, 25 | B-47 | Anti-iced with retractable screens. |
| J47-GE-27 | F-86F | Anti-iced with retractable screens. |
| J35-A-5 through -33 | F-84, B-45 and early F-89s | Not anti-iced, screens may be removed. J35-A-21s will be anti-iced by modification. |
| J35-A-35 through -41 | F-89 late series | Anti-iced with some series having retractable screens. |
| J33 and J48 | F-80, T-33, F-94 | No provision for anti-icing considered necessary. |

**Design specifications call for anti-icing on all new model engines being developed for service.**

### Test Methods

From tests, it was found that ice in the induction system of jet engines could be eliminated by various means. Among the methods tested were surface heating by hot compressor air, continuous electrical heating and controlled alcohol flow. Surface heating proved successful when applied to inlet guide vanes and island fairings, but heating of inlet screens has not yet proved to be practical. Research on inlet screen anti-icing is continuing.

Northrop reported some success with use of an ice indicator and controlled alcohol flow on F-89 type aircraft, but this system was subsequently dropped. Weight factors, adaptability, cost and other criteria were considered in determining which method was most feasible.

General Electric has adopted the method of using compressor bleed-air forced through hollow inlet guide vanes with variations of continuous heat application, and automatic heat when needed, in addition to retractable air inlet screens. Newer Allison engines also incorporate a retractable air inlet screen with the use of automatic heat applications from compressor bleed-air.

The use of compressor bleed-air is a natural application for the axial flow engine. Compressor air is heated to over 450°F. from an ambient air temperature of 60°F. under normal operation. This is more than ample to eliminate icing. The bleed-air is used to heat and give complete anti-icing protection to the inlet guide vanes, island fairings and strut jackets.

The removal of screens in axial flow engines is an approved procedure for eliminating icing hazards in winter operations for those aircraft not equipped with inlet anti-icing. Screen removal (Ref: T.O. 01-1-469) is left up to the local commanders' discretion, since the added hazard of compressor damage from runway foreign particles has to be weighed against the possibility of icing.

For aircraft equipped with anti-icing systems, protection consists of (1) retractable compressor inlet screens, and (2) hot air already bled from the compressor. The compressor air is used for partially counteracting the thrust load on the #2 bearing and is passed through hollow inlet guide vanes and special manifolding on the front of the forward frame struts. Thus the guide vanes and struts are adequately protected with no loss in performance. This protection is continuous whether or not icing conditions are encountered.

Additional compressor air is bled and led through special manifolds on the island fairings. Provisions are made for using this same air to heat the accessory cover (bullet nose). Island fairings and the accessory cover are heated only when icing conditions are encountered since the additional air extraction does result in some small loss in thrust (1—2%). This system may be turned on and off by means of a solenoid operated valve which will fail safe in the "open" (on) position, in the event of electrical failure.

### Learn the Facts

The facts of jet engine ice formation should be learned and respected; however, there is no reason to fear engine icing provided operating personnel understand its symptoms and effects and plan accordingly. Meteorological information should always be studied for flight planning and ground runup to determine where conditions may be expected which are conducive to engine icing.

When icing conditions are encountered, ice should not be allowed to build up in the induction system of those aircraft equipped with manually operated anti-icing devices. When the anti-icing device is turned on after the ice has built up, there is a possibility that large pieces will break loose and damage the compressor rotor and stator blades or cause a flameout.

Screens should be retracted before ice forms and prevents retraction. Particular caution should be used during landing approach, where ice formation may result in loss of power and excessive tailpipe temperatures in case of a go-around.

For those aircraft not equipped with engine anti-icing devices, the following procedures should be considered:

1. Immediately upon recognizing the indications of engine icing — increased tailpipe temperature and loss of thrust — while flying in clouds or air with high relative humidity and low temperature (plus 15° C. to plus 0° C.), the pilot should retard the throttle, reduce airspeed and get out of the icing area.

2. Fuel flow variations should not be used to detect jet engine icing since contradictory signals are sent to the main fuel control during ice accretion.

3. If the icing area is a cloud entered from below, descend immediately while reducing throttle. If the cloud was entered horizontally, make a 180° turn while retarding the throttle and reducing airspeed. If the cloud layer is thin stratus, attempt to climb and get above the cloud while reducing throttle and airspeed. Leaving the icing area is the only method possible for eliminating inlet screen and guide vane icing in aircraft equipped with non-retractable inlet screens.

When engine icing has progressed far enough to cause an excessive tailpipe temperature and loss of thrust followed by an explosion and flameout, an attempt to air restart could result in more explosions or fire.

To illustrate the symptoms of jet engine icing, one F-84 pilot who encountered engine inlet screen icing in flight is quoted:

"I was climbing in formation somewhere between 11 and 13,000 feet. At the time, I checked my airspeed at about 215 mph. I was also looking at the tailpipe temperature and noticed it going up slowly and steadily, so I cut back power to about 80 per cent, shoved the nose down and regained airspeed of 300 trying to stay on heading. I climbed out of the cloud at about 15,000 feet after I regained my airspeed and then increased the throttle setting to 90 per cent. My tailpipe temperature had gone up too high. It went up to between 775 and 800 degrees before I cut back the power. I encountered no further trouble and returned to base."

Another F-84 pilot in the same flight gave this account:

"After we entered the cloud I lost contact with my flight leader in front of me. Immediately after that I had a flameout. My fire warning and overheat lights came on and my tailpipe temperature went up and hit the peg. I also had at the same time — I don't know whether you would classify it as an explosion — but it was the same type of sound you have when you change from your normal fuel system to your emergency. I slowed my airplane down to approximately 240 mph. When my rpm reached approximately 18 per cent, I switched to alternate and tried an airstart. As soon as I opened my throttle up, I had a fire warning light go on and overheat light with 1000 degree tailpipe temperature."

This pilot was forced to eject.

Whether you are flying an aircraft with or without anti-icing equipment, know what to do when you meet icing conditions. Don't be caught unexpectedly. Plan your flight to avoid the ice, when possible, or if you have anti-icing equipment, "anti-up" before you enter the icing area. ●

## Jets and their pilots are built to withstand stresses but there is a limit to everything. Men and machines are no exceptions

### By Captain Edmund F. Hogan, ANGUS

IN the good old days of aviation the red line on the airspeed—if there was one—was fixed solely by structural limitations.

The speed of modern jets, however, is limited both by structural limitations and compressibility effects. The approach of compressibility is easily measured by the Mach number which, brieflly, represents the ratio between the speed of the aircraft and the speed of sound. As the airplane reaches toward the speed of sound, the airflow at some point on the aircraft's surface arrives at the point first. This is not as complicated as it seems at first glance. What happens is this:

The aircraft's wing forces the air to flow around it in something other than a straight line. This deflected air travels farther than the straight line distance between leading edge and trailing edge of the wing. Consequently, it moves faster flowing around the wing than the straight line between two points. Thus, when the aircraft gets quite close to the speed of sound, the speed of the air flowing around the airfoil has already reached sonic velocity. In modern jet fighters this usually occurs at Mach .8 or .9 for the aircraft. This means that when the machine is flying at eight-tenths or nine-tenths of the speed of sound, the air is flowing over some part of the plane's surface at Mach 1. It is then the effects of compressibility becomes noticeable.

Wartime conventional fighters tended to pitch down when they reached compressibility. Modern jets usually pitch up as they arrive at transonic speeds with the exception of the very high speed, thin wing type. At altitudes above 25,000 feet, the pitch-up is less severe than that which occurs upon reaching transonic speeds or compressibility at a point below 15,000 feet. Further, the pitch-up at altitude is overcome more easily, normally with forward stick pressure.

In the final analysis, compressibility occurs or does not occur pretty much as the jet pilot wills. For this reason flight technique is of utmost importance. Two instruments are invaluable aids to the pilot—his airspeed indicator and Mach meter. A third instrument, the accelerometer, is concerned with G forces which will be discussed subsequently.

The speed of sound is not constant. It varies with temperature and density altitude. It reaches its maximum at sea level and decreases with altitude. On a standard day at sea level the speed of sound is 761 mph. At 35,000 feet it is approximately 670 mph. As a rule of thumb, jet aircraft will hit the transonic zone at an indicated airspeed of 670 mph at sea level; 545 mph at 10,000 feet, 460 mph at 20,000 feet and 290 mph at 40,000 feet. The airspeed indicator is equipped with an extra needle, painted red. It is calibrated to indicate constantly—regardless of altitude—the point at which the aircraft will begin to enter compressibility.

More accurate than the airspeed indicator is the Mach meter. This is red-lined at the critical speed, or Mach number, for the particular type of aircraft. It relates airspeed in terms of Mach value and serves as an excellent cross-check on speed.

The accelerometer tells the story of G forces. These are the second limiting factors being imposed upon the aircraft. The instrument is red-lined at the various critical G forces, and common sense should dictate caution. Exceeding the G limitations can only lead to trouble.

The force of gravity equal to the weight of the aircraft is expressed as G. This is a one-G force. At four G's the force of gravity is four times the weight of the aircraft. Jet aircraft are built to withstand great stress loads. Generally speaking, except for shock loads jet aircraft can handle a limit load of 7.33 positive G's in their clean configuration. But design specifications provide a safety factor of 50 per cent, which means that the load could go as high as 11 (positive) G's. Naturally we do not recommend piling on the G forces needlessly—but that safety factor can be comforting when really in a bind.

The manner and direction in which forces are applied in relation to the aircraft and the body are of prime importance. When the force is directed from the head to the feet, the G is said to be positive. When the force is directed from feet to head, the G becomes negative.

If an aircraft is designed for a limit load of 7.33 positive G's, it should permit this number to be pulled as often as desired without damaging the aircraft. Wrinkles and popped rivets result when the limit load factor is exceeded. Beyond 11 positive G's structural failure may usually be expected. In this respect, accelerometers do not give true readings for shock-type loads such as are encountered in hard landings.

Still, the jet pilot who looks forward to the luxury of puttering around a house financed from retirement annuity funds, might inspect closely this area of G forces. For instance, it is possible to pull positive G's safely, starting at the red-line airspeed, provided the aircraft is in a very shallow dive. In such a maneuver the aircraft slows up as the G's are applied. By the time the load has built up to 7.33 positive G's, the aircraft has lost from 35 to 50 mph because the aircraft automatically loses speed with the application of the G's and it does this rapidly enough to avoid effects of compressibility.

On the other hand, if the aircraft is in a steep dive and has been picking up speed, it will not slow down as

# YOU VS "G" AND

the G's are applied. In this instance the speed of the aircraft is increasing during the application of the G's and could easily exceed the limiting Mach number at the time that 7.00 or more positive G's were being applied.

Stability of the aircraft will change, usually at the time when it is approaching the ground rapidly. More often than not in such an instance the aircraft simply runs out of altitude before a pull-out can be effected.

Speed and G forces can be considered separately but in the actual practice of jet flight, they march hand in glove. So present-day designs require that the pilot be familiar with the VG diagram. The "V" stands for speed or velocity, and the "G" obviously for G load. The diagram is an essential part of the basic design of each aircraft. As soon as the designer determines the wing loading, power loading and intended performance, he plots the VG diagram. This diagram is included in the Tech Order for each type of jet aircraft. If thoroughly understood, it eliminates experiments of the trial and error kind, for it tells the jet pilot the limitations of his aircraft before he ever leaves the ground.

The VG diagram shows how stall and compressibility limit maneuverability at various altitudes. The curved line on the left of the diagram represents the stall boundary, indicating at what combination of G's and speed it is possible to stall the aircraft. One section covers the complete speed range of the airplane and extends from the negative to positive G load limit. This area constitutes the legitimate maneuvering range pilots can use.

The diagram will prove that modern jet fighters can fly at speeds sufficiently fast in level flight for structural failure to occur. It proves, too, that whenever a modern jet fighter operates at low altitudes, it is flying in a region where indicated airspeeds build up tremendous dynamic pressures on the aircraft. Considering the fact that the VG diagram contains so much valuable information, it is strange indeed that so few checkout questionnaires refer to it.

With the development of high-speed aircraft much attention has been directed toward the pilot's ability to withstand the G forces associated with acceleration. The sense of urgency has been greater in the last few years because designs for speed have progressed so far in such a relatively short time. But in fact the study has been continuing since World War I, when extensive experiments concerning the effect of centrifugal force on the brain were conducted.

Many jet aircraft have been damaged badly because a pilot pulled positive G's in excess of the designed strength. Damage has ranged from minor wrinkling of the wing skin to tearing off the wings and disintegration.

### "G" Tolerance

An Air Force study of human factors in major accidents of jet aircraft notes that the average pilot has a tolerance to positive G forces of approximately 6 G's for 15 seconds, 7.5 G's for five seconds and 9 G's for three seconds (providing the 9 G's are reached in one second), without the use of the G Suit. But this was found to be true only if the individual was in good mental and physical condition and was actively resisting the effects of positive G forces by straining both leg and abdominal muscles. Straining these muscles helps the blood return to the heart.

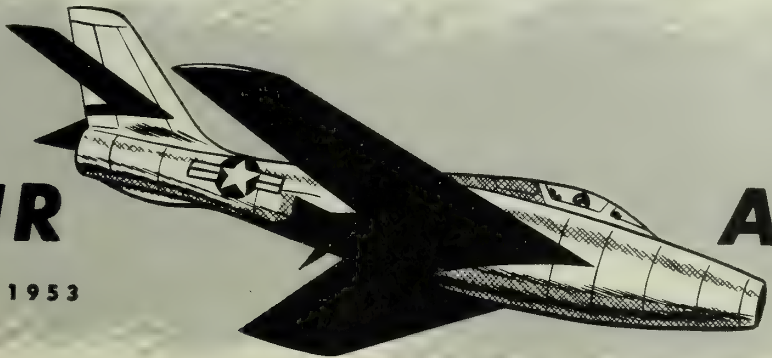
If the pilot relaxes his muscles virtually all of the blood will pool in the lower portion of the body, insufficient blood will return to the heart and the heart will be unable to maintain circulation in the head. And when circulation through the brain stops, unconsciousness follows in three to four seconds. Recovery from unconsciousness produced by high G forces is slow and is accompanied by convulsions followed by a state of mental confusion. The average pilot would not be able, the survey states, to control an aircraft for at least 20 seconds after losing consciousness under high G forces even if the G forces were lowered immediately.

A number of physiological and psychological stresses alter the tolerance to G's. Worry can cause a pilot to forget to tighten his leg and abdominal muscles. So can lack of sufficient oxygen, carbon monoxide in the blood stream, upset stomach, gas pains, and so forth. Additionally, there are definite stresses which directly lower tolerance to G forces by decreasing elasticity of blood vessels. If the blood vessels relax completely, the volume of the blood vessel system of the body increases so much that there is not one-half enough blood to fill it, and even one positive G cannot be tolerated. There can be various degrees of relaxation of the blood vessels which would produce various degrees of tolerance to G forces. An individual can and does vary from day to day, depending upon his state of health and well-being.

Nausea from any cause is accompanied by a relaxation of central blood vessels, a slowing of the heart's rate of beating, a lowering of blood pressure, and a very marked decrease in tolerance to a positive G force. A nauseated individual may not even be able to tolerate one G.

Always present in aerial maneuvers is the possibility of vertigo. Further, there is the possibility of upset stomach, excessive heat, hypoxia, high G forces and emotional disturbances. Physiologists and others concerned with a pilot's ability to withstand G forces encountered in high speed flight advise that a pilot should break off a mission and return to his base whenever he feels "bushed." Bravado, they observe, is a poor excuse for loss of life and expensive equipment.

The jet pilot, they note, would be well advised to keep in mind that he —and his machine—have limits beyond which it is not safe to experiment. ●



# Flying a Flameout!

**Scientific research and experiments with simulated flameout landings have resulted in revised techniques for deadstick landings in jet aircraft.**

### By Maj. Robert M. Stevens, Fighter Branch, D/FSR

EVER since the first pilot took off in his spit-and-paper kite, the problem of deadstick landings has been throbbing in the recesses of his mind. In the old days of the Nieuport, every landing was, for all general purposes, a deadstick . . . it had to be . . . the Gnome-LeRhone had no throttle, and to make a landing you just toggled the cut-out switch and blipped her on in to a walkaway landing.

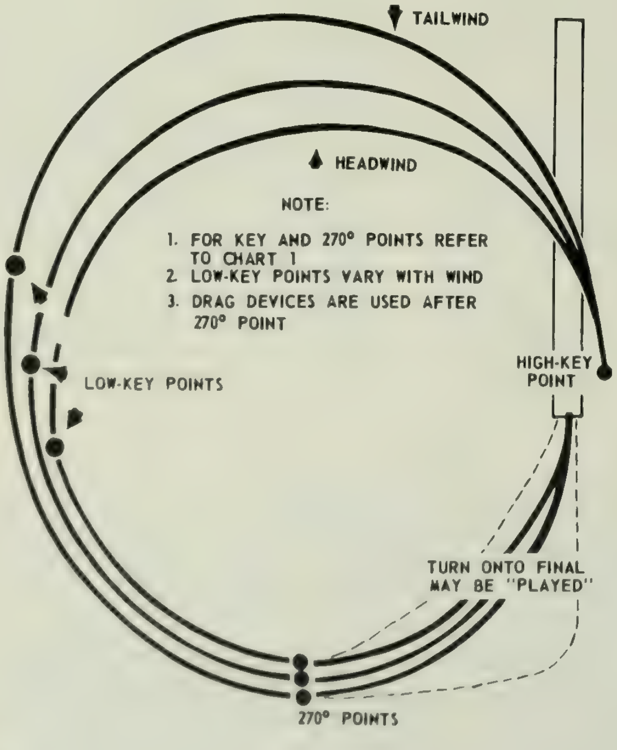
Came the era of the carburetor, and the intrepid aeronaut still kept glancing around for a landing area, just in case his mill quit. And now, with jet propelled airplanes, he still keeps his neck on a swivel and plans what he will do if he loses his fire. About the only *genus aviator* who doesn't worry about deadstick landings is the glider pilot, and he wouldn't know what to do with a throttle if he had one.

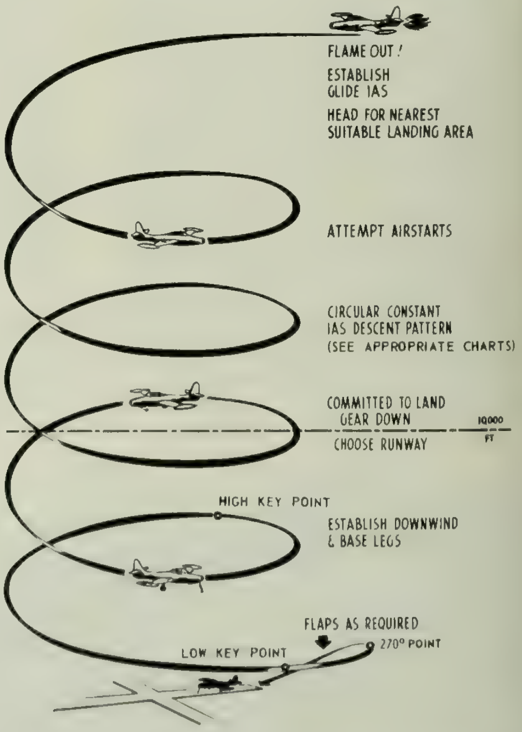
In order to further the science of putting down a jet job stone cold dead in de market, the Directorate of Flight Safety Research requested Air Research and Development Command to run a series of simulated flameout landings in various types of jet aircraft. The results of these tests were previously described in FLYING SAFETY.

A basis for the claim that this research has paid off in terms of aircraft dollars saved, is the letters received from all major USAF commands, outlining the number of successful (minor or no damage) forced landings accomplished in each command.

These figures, coupled with data researched by the Directorate's Records and Statistics Division, indicate that the U. S. Air Force-wide "practice" or simulated flameout landing program has been extremely successful.

Comparing two periods, the first from 1 November 1950 to 31 October 1951 (before practice), and the second from 1 November 1951 to 31 October 1952 (after practice), it was proved that the accident rate in this category decreased 29 per


TAILWIND
HEADWIND
NOTE:
1. FOR KEY AND 270° POINTS REFER TO CHART 1
2. LOW-KEY POINTS VARY WITH WIND
3. DRAG DEVICES ARE USED AFTER 270° POINT
HIGH-KEY POINT
LOW-KEY POINTS
TURN ONTO FINAL MAY BE "PLAYED"
270° POINTS


FLAME OUT !
ESTABLISH GLIDE IAS
HEAD FOR NEAREST SUITABLE LANDING AREA
ATTEMPT AIRSTARTS
CIRCULAR CONSTANT IAS DESCENT PATTERN (SEE APPROPRIATE CHARTS)
COMMITTED TO LAND GEAR DOWN
10,000 FT
CHOOSE RUNWAY
HIGH KEY POINT
ESTABLISH DOWNWIND & BASE LEGS
FLAPS AS REQUIRED
270° POINT
LOW KEY POINT

cent in the second period. This point is further emphasized by the fact that although total jet flying hours increased 48 per cent in the second period, the dollar loss increased only 11 per cent, for an estimated saving of several million dollars. Because of 175 successful forced landings during both periods, the savings in airframe costs alone is estimated at nearly 20 million dollars.

The study of jet flameouts is not static. It is set up on a continuing basis by Air Research and Development Command, in order to obtain ultimate information on jet flameout landings under all conditions in present and future jet fighter types. In addition, the Directorate of Flight Safety Research continues to study and recommend new techniques, based on thorough analysis of jet fighter accidents, and this information will be disseminated to pilots through Pilots' Handbooks and other printed media.

### Tests Conducted

Flight tests were conducted at Edwards Air Force Base in 1952 to determine the best possible procedures in flameout landings for F-84G, F-86E, F-86D and F-94C aircraft.

In the analysis of this information it was discovered that certain basic changes would improve the previously recommended landing pattern. The major change is the modernization of the circular (360-degree overhead) landing pattern and the readjustment of key point altitudes as shown on the accompanying charts.

In addition, the Edwards AFB test report states that it has now been proven that the hydraulic irreversible "normal" flight control system on F-86E and F-86D airplanes is fully operable with the power provided by a windmilling engine. Another significant finding of the later tests is that landing flaps on F-86E and F86D airplanes can be used on final approaches as a result of the new interconnected flap design.

Improvement of the pattern used in the early flameout landing study as prepared by the Directorate of Flight Safety Research was recommended by test pilots at Edwards AFB. This revision calls for three pattern points, with corresponding altitudes, rather than the two points used in the original tests.

The first or "High-Key" point remains in the same geographical pattern location and is established on the initial approach at a specified airspeed and altitude with gear down and locked. At this "High-Key" point a specific and constant rate-of-turn should be started and maintained until the 180-degree or downwind point is achieved. Here is the point where a positive decision must be made by the pilot, and depending on the prevailing wind, the pattern must be "played" from here on. As this 180-degree point is the location of resolution and is the spot where the pilot must make his first evaluation of his ability to properly hit the runway, it is now known as the "Low-Key" point. The last significant altitude is at the 270-degree (base leg) point. From here to touchdown, a successful landing is effected through the proper use of flaps, speed brakes, and if necessary, controlled side-slips and fishtails. (Consult the Dash-One T. O. for slip restrictions on your aircraft.)

The aiming points on the runway remain unchanged. For a headwind condition, shoot for the midpoint of the runway; if a tailwind prevails, shoot for the first third of the runway.

As in all flying techniques, there must be a flexibility of pattern to conform to the hundreds of varying conditions. The figures shown in the charts on this page are for optimum conditions only in the sense that the resulting pattern is easily flown and gives accurate results.

It is possible to perform the entire 360-degree pattern at altitudes different from the values shown, depending upon the judgment of the pilot. If you happen to come out at the High Key point at an altitude lower than that specified, it is possible to complete the approach by cutting the pattern smaller, with accompanying increased rates of turn. However, these steep, tight turns can become uncomfortable with boost off.

At this point, the difference between emergency and forced landings should be emphasized. The following descriptions of a "forced" and an "emergency" landing still hold good.

An emergency landing is a precautionary landing made at the pilot's election, and under conditions where he has control of power and flight controls.

A forced landing is a landing under conditions where loss of power control or partial loss of flight controls precludes further flight.

A word about canopies. It is important that all canopies be jettisoned in setting up the airplane for a forced landing. In emergency landings, sliding canopies should be opened and

## Actual Flameout Data

| Aircraft Type | F-84G | F-86E | F-86D | F-94C |
|---|---|---|---|---|
| High-Key Altitude—Ft. | 5,500 | 6,000 | 6,500 | 10,000 |
| Low-Key Altitude—Ft. | 2,500 | 3,000 | 3,500 | 5,000 |
| Base (270 deg pt) Leg Alt—Ft. | 1,300 | 1,500 | 1,500 | 2,500 |
| Best Glide IAS—K (Gr Down) | 180 | 185 | 185 | 175 |
| Rate of Desc—Ft/Min (Gr Down) | 2,150 | 2,800 | 3,050 | 2,600 |
| Rec Rate of Turn (Gr Down) Deg/Sec | 3 | 3 | 3 | 1.5 |
| *Rec Final IAS—Knots | 150 | 150 | 150 | 160 |
| *Rec IAS at Touchdown—K | 120 | 130 | 135 | 120 |
| Best Glide IAS—K (Gr Up) | 190 | 185 | 185 | 185 |
| Rate of Desc—Ft/Min (Gr Up) | 1,600 | 1,850 | 2,100 | 1,900 |
| **Rec Rate of Turn Deg/Sec (Gr Up) | 3 | 3 | 3 | 1.5 |
| ***Rec Alt for Lowering Gr Nor Sys—Ft. | 12,000 | 12,000 | 12,000 | 15,000 |
| Approx. Pattern Radius—N. Mi. | 1 | 1 | 1 | 2 |
| Avg Windmill RPM Below Hi-Key-% | 12.5 | 13 | 13.5 | 7 |
| Avg Test Time fr Hi-Key to T. O. | 2.2 | 1.7 | 1.8 | 3.3 |
| Avg Time for Gr to Lock Dn—secs | 25 | 15 | 27 | 19 |

* Assuming no wind and approximately 600 lbs. of fuel remaining.

** Completely elastic depending on position and altitude.

*** Only if the field is definitely within gliding distance. Rates of descent were taken at 15,000 ft. with gear up and 5,000 ft. with the gear down.

## Flameout Simulation Data
## (Boost Off, Except for the F-94C; Speed Brakes Out)

| AIRCRAFT TYPE | F-84G | F-86E | F-86D | F-94C |
|---|---|---|---|---|
| Best Glide IAS—Knots (Gr Up) | 190 | 185 | 185 | 185 |
| Avg Rate of Desc 25-12,000 ft (Gr Up) | 1,650 | 1,850 | 2,200 | 1,900 |
| Avg Power-RPM-%, 25-12,000 ft | 65 | 72 | 79 | 79 |
| Best Glide IAS—Knots (Gr Dn) | 180 | 185 | 185 | 180 |
| Avg Power-RPM-%, 15,000′ -SL (Gr Dn) | 58 | 69 | 74 | 69 |
| Rec Alt for Lowering Gr (Ft Abv Grnd) | 12,000 | 12,000 | 12,000 | 15,000 |
| Rec Rate of Turn—Deg/Sec | 3 | 3 | 3 | 1.5 |
| *Best Final IAS—Knots | 150 | 150 | 150 | 160 |
| *Rec Touchdown IAS—Knots | 120 | 130 | 135 | 120 |
| Fuel Consumed, 25,000 ft-SL lbs. | 100 | 235 | 165 | 205 |

*Assuming no wind and approximately 600 lbs. of fuel remaining.

## Pattern Altitude Variations

| A/C Type | High Key Alt --- Ft. | Low Key Alt --- Ft. | 270 Deg Point Alt --- Ft. | Corresponding Rates of Turn Deg/Sec |
|---|---|---|---|---|
| F-84G | 3500 - 7500 | 1700 - 3700 | 900 - 1700 | 4 - 2 |
| F-86E | 4000 - 8000 | 2000 - 4000 | 1000 - 2000 | 4.5 - 2 |
| F-86D | 4500 - 8500 | 2200 - 4200 | 1000 - 2000 | 4.0 - 2 |
| *F-94C | 8500 - 11500 | 4200 - 5800 | 2000 - 3000 | 2 - 1.5 |

*The F-94C pattern is designed around the handling qualities of the airplane without boost to be entirely safe in the event of boost failure in the pattern.

the jettisoning of clamshell canopies left to the pilot's discretion.

The recorded experiences of over 600 jet fighter pilots who have had to evacuate crashed aircraft clearly indicate the desirability of pre-crash canopy removal. Of these pilots, 110 experienced difficulty in canopy removal following a crash landing. As a direct result of post-crash fires, six received fatal and seven received major burn injuries. Eight others trapped in cockpits of burning aircraft were saved only by the prompt action of crash crew personnel. An analysis of these accidents proves conclusively that the majority of crash-landing injuries were not caused by impact forces and prompted the recommendation to jettison the canopy prior to execution of a forced landing.

Here is another moot point which you F-86E, D and F jockeys had better paste in your helmet. Comes a turbine seizure (and you will know it when you get complete, *but complete,* loss of rpm), get ready to go over the side. Of course if you are over an established airfield at a fairly low altitude, and you are sure that you can make the field, then best ride it down. Remember though, in the F-86E, F and D models without engine windmilling, your alternate flight control is dependent on the battery, and the battery may last only a few minutes.

Another point along this line: With a seized turbine, your rate of sink increases about 35 per cent over normal gliding ratio.

We cannot stress the point too strongly that the information contained in the studies of flameout landings be used constantly in the education of jet pilots, regardless of their experience level. These facts should be impressed indelibly on the mind of every man who flies a jet, until his reactions in making a flameout landing become natural reflexes. The end result will be a further improvement in flameout landing accident rates. ●

A study of 97 jet fighter forced landing accidents shows that your walkaway chances in this unpopular type of landing are good. This is attributed mostly to the higher stressed cockpits—high G-force seats and the wearing of the shoulder harness. To use statistics: 98 per cent of the aircraft involved were substantially or totally wrecked; yet, 75 per cent of the pilots were not injured. When one considers that 95 per cent of these jet forced landings were accomplished without a fatality, the picture becomes even brighter.

There is still no substitute for the calm analysis and keen judgment required to handle an emergency: these are personal attributes of the individual pilot.

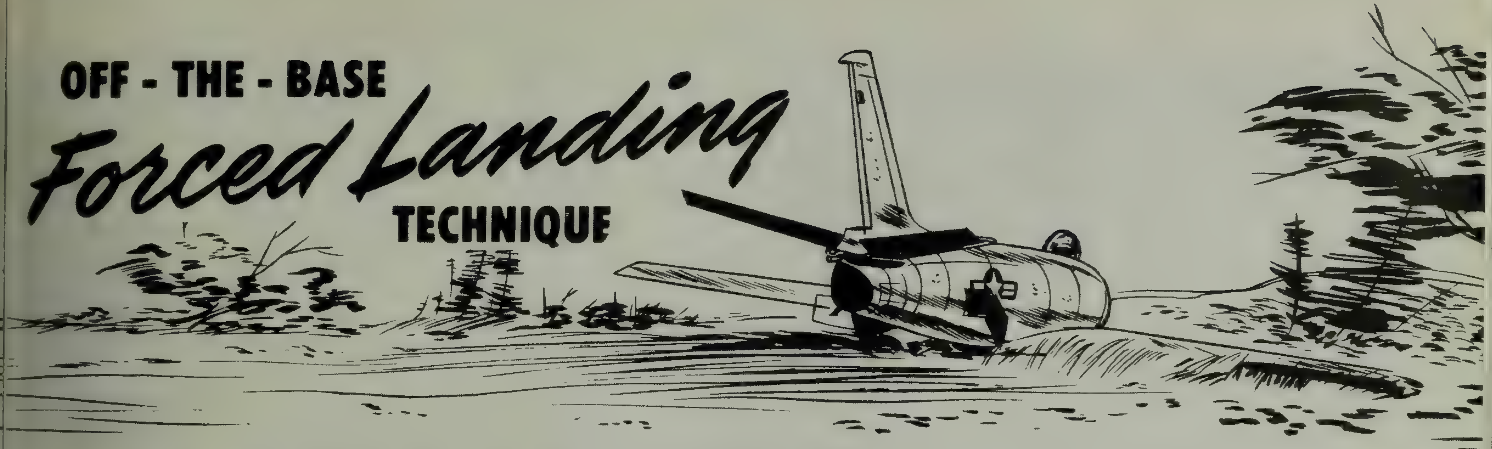
Airstarts call for more practice. In more than 28 per cent of the forced landings due to flameouts, airstarts were unsuccessfully attempted. While the reason for the failure of these engines to start was not always known, the Forms 14 often showed that airstart procedures were either too hastily or incorrectly performed. This phase of training is one that cannot be "over-learned."

Fuel exhaustion, a factor most vital for jet pilots in their preflight planning, showed up in the survey with alarming regularity — approximately 25 per cent of total causes of forced landings. Here again is reflected inadequate training in flight planning, or an utter disregard for the range limitations of jet aircraft. Here too, as a contributing factor, is poor flight leadership. In four accidents, wingmen became separated from their flight leaders, subsequently became lost, exhausted their fuel while stooging around looking for a field, and finally had to crash-land.

### Primary Cause Factor

The primary cause factor leading up to the emergencies was powerplant failure with 51 cases, or 53 per

# OFF - THE - BASE *Forced Landing* TECHNIQUE



cent. ARDC and AMC have a continuing project to improve the reliability of jet engines. New manufacturing techniques have resulted in a general decrease in jet engine failure rates during the past two years.

Another obstacle that hindered these pilots was loss of flight control boost, because of insufficient hydraulic pressure. This condition led to at least one fatality and was a suspected factor in three others. Several other pilots were so occupied in maintaining aileron control that they failed to plan their approach properly and wrecked aircraft resulted. The answer to this problem is that it is essential that any program of practice forced landings be done with flight control boost off, in order to familiarize pilots with the possible loss of this system under emergency conditions.

Flaps and speed brakes were used in about 60 per cent of the landings. However, full dependence on these controls will not prevent overshooting or undershooting of the intended landing area, for many of the overshooting planes had flaps down. These accidents occured before the practice jet fighter forced landing program was accepted training. The pilots were not familiar with simulated dead engine flight characteristics and generally made high, fast approaches. Then, too, perhaps they had never been briefed in the slipping or "fishtailing" characteristics of their aircraft and did not use this method to lose altitude and airspeed. (Consult your Dash One T. O. for slipping restrictions on your aircraft.)

### Approaches Important

Approaches are most important in this business of staying in one piece. Rectangular patterns with straight-in approaches outnumbered the 360° overhead pattern in power off landings, three to one. In making the 360° "pitchout" tactical pattern, the pilot's judgment was affected more adversely than in the straight-in type. Of 21 pilots who used the tactical approach, more than 50 per cent overshot; 25 per cent undershot, and the remaining percentage hit their intended landing area.

The rectangular pattern was favorable to the pilot. Fifty per cent of the pilots in this category put the aircraft down in the intended landing area. These figures point to a large spiral type descent over the intended area (if altitude is to be lost) with a rectangular pattern plus a straight-in final, as being good solid emergency flying.

In report after report the killer was excess airspeed on final and touchdown. Without engine power, hydraulic pressure or electrical power a pilot sometimes does not have flaps or speed brakes; however, the stalling speed of the aircraft is the same as the power-off configuration as shown in the Dash One T. O.

It is the psychological effect of having to "groove it" that undoubtedly influences the thinking of the pilot. For fear of undershooting the pilot subconsciously compensates by building up excess airspeed. Speeds of 60 knots above normal approach speed were not uncommon. This condition has proved just as disastrous as the low airspeed antic.

Regarding this high-speed approach, pilots placed too much emphasis on the fuel-load speed ratio and in many instances came in far too fast. Actually, a good rule-of-thumb calls for adding five knots above normal approach speed for every 100 gallons of fuel over normal landing load. On this basis, 15 knots would be the maximum airspeed increase required for a full internal load. It is assumed that the external tanks will be salvoed in plenty of time to insure getting rid of both.

The following is a general SOP covering both the pre-landing emergency and the actual forced landings:

★ When the emergency occurs, head for the nearest field.

★ Set up proper glide according to A/C Tech Order. (Better know your Dash One, buddy.)

★ Airstarts should be attempted (if engine is not damaged) down to approximately 10,000 feet above terrain. It is this altitude where a decision to bail out or crash-land can be more accurately made.

★ If an airport landing is to be attempted on a known runway length, gear should be down and locked at sufficient altitude to enable the pilot to concentrate on pattern work. If the gear cannot be completely downlocked, either by normal or emergency methods prior to final approach, it is safer to retract the gear for a belly landing.

★ As for pattern. the one shown in the accompanying diagram is the best proven method of spiking it in the intended landing area like an old pro.

★ Flaps and speed brakes should be used, if available, to lower the aircraft's touchdown speed. In water landings, the flaps will rip off or "give" on impact and not cause a nose-in effect. *Landing gear should be up on all ditchings!*

★ Jettsion external loads before entering the pattern, if possible. Sliding distance will be lessened. Wing tanks, if empty, will afford additional buoyancy in ditching, however.

★ Canopy should be opened or jettisoned at pilot's discretion prior to final approach.

★ Make sure shoulder harness is tight and locked—also that helmet is on securely.

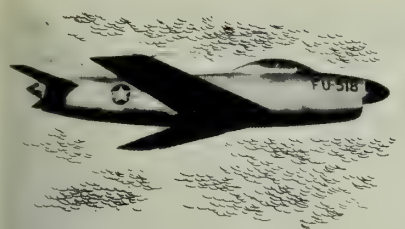
★ Cut the fuel and switches off when "you've got it made."

# Weather Briefing

## FOR JET PILOTS

By Capt. Rolla C. Griffith

In this article Captain Griffith, a jet pilot and weather [illegible] the elements which he thinks are necessary in a complete weather briefing to help those who may face this problem in the future.



THE briefing of combat crews flying jet fighters is a job comparatively new in the Air Weather Service. Although the elements included in such a briefing are generally the same as those given to conventional pilots, the speed at which jet aircraft operate and the vast difference in fuel consumption at various flight altitudes necessitate additional information in the briefing. The type of mission to be flown determines which elements may be eliminated, while the importance of others must be stressed.

### Winds

The wind direction and velocity for the 10,000, 20,000, 30,000 and 40,000-foot levels must be given accurately. The amount and type of ordnance carried by the aircraft depend on the winds aloft and whether the winds will be beneficial or detrimental. It appears that a headwind on one leg of the flight would be compensated for by the resulting tailwind on the opposite leg but this is not true in jet operation. A headwind on the flight to the target requires a reduction in the ordnance load because the aircraft is unable to attain optimum altitude with an external load.

The first principle of jet operation is that as the flight level increases, the fuel consumption decreases, and fuel consumed on the trip to the target cannot be compensated for on the return flight regardless of the flight altitude.

The minimum fuel load with which the aircraft must break combat or leave the target area is computed prior to takeoff, and the wind forecast is of prime concern to the operations officer who makes the decision on the minimum fuel figure. To have a jet land with an extra 100 gallons of fuel aboard because of a poor wind forecast is a great waste. One hundred gallons of fuel means five minutes flying time at 1000 feet, but 35 minutes at 40,000 feet. The importance of accurate wind forecasts cannot be overemphasized.

### Pressure Altitude

The optimum altitude is the most efficient altitude at which the aircraft can proceed to and return from the target. Optimum altitude is given as density altitude and the weather officer converts it to pressure altitude, which the pilot reads directly from the altimeter by taking into consideration the temperature correction. The indicated or pressure altitude varies with warm and cold air advection aloft.

In warm air, fuel is saved because the jet can fly at a lower indicated altitude and still be at optimum. For example: If 30,000 is the optimum and the temperature at 30,000 feet is —35°C., the pilot must climb to an indicated 31,000 feet to be at the optimum of 30,000 feet. This is a simple calculation on an E6B computer, available in any operations office.

### Target Winds

For increased accuracy on dive bombing missions the surface wind must be taken into consideration. If an approximation is given at briefing, then the direction of the dive bombing run and release altitude are planned before takeoff. Briefing on the prevailing wind direction and velocity below 10,000 feet serves a secondary purpose.

Interrogation of pilots who have bailed out of their aircraft over enemy territory brought out one fact. Had they been aware of which direction they would drift after jumping, their bailout could have been planned more carefully. One pilot stayed with his plane until an instant before it exploded in order to get out over the Yellow Sea. Actually, he could have jumped much sooner and been carried over the water by the prevailing wind. This was particularly applicable in combat areas such as Korea where a landing in the water meant almost certain rescue.

### Runway Temperatures

The ambient temperature is all-important in jet operation. Warm days lengthen the takeoff run, lower the ordnance load, and reduce the efficiency of the jet engine by lowering the amount of thrust available at maximum power settings. The reasons for this may be found in any manual explaining the principle of jet propulsion. For example: With a 6000-foot runway and a runway temperature of 40°F., an F-84 can carry an external load of over a ton. At 80°F., the load is reduced to 700 pounds, and with a 95°F. temperature the external load becomes zero.

Mechanical aids are used when temperatures are high, but an accurate temperature forecast is essential for planning purposes. Many elements affect the runway temperature. They are: amount of cloud cover, surface wind direction and velocity and the construction of the runway. Radiation differs slightly on pierced steel plank, concrete and asphalt.

### Freezing Level

Glaze and rime icing are of minor importance to jet aircraft because their cruising altitude is high enough that all mosture is in ice crystal form.

The ascent and descent through the dangerous icing levels are made at speeds which allow the ice a minimum of time to form on the wings and control surfaces. The intake screen is the danger point. When glaze ice forms over this screen, no air reaches the impeller section and engine failure results. (See article on Jet Icing in this issue, page 16.)

Areas of super-cooled droplets, such as thunderstorms, are the most dangerous and must be emphasized. Windshield icing is picked up on all descents through clouds, but normally is of little importance. Frost forecasts to the maintenance section are necessary to insure placing protective coverings on the aircraft at night.

### Target Temperature

Briefing on the temperature in the target area and of bodies of water flown over or near is very helpful information for the combat crews. An example of poorly informed pilots are those who dress for the temperatures at the home base regardless of the temperatures in the area where they might be forced down. The jet pilot is overburdened with equipment, and anything the forecaster can do to lighten the load is helpful. If they are informed, they may dress to suit the weather for all areas over which they fly.

### Synoptic Situation

For briefing, the weatherman and pilot should go over a map which covers a large enough area to show the pressure system and frontal locations affecting the route of flight. Also, a pictorial cross section should be studied showing just exactly what the pilot may expect in connection with the synoptic situation. Weather information graphically displayed is more easily assimilated.

### Altimeter Setting

Under instrument conditions an altitude is decided upon as the minimum to which the aircraft will descend in the overcast. There is no problem at an established base where

## JET WEATHER HIGHLIGHTS

★ *Winds* . . . The amount and type of ordnance carried by the aircraft depends upon winds aloft.

★ *Altitude* . . . The optimum altitude is the most efficient altitude at which the aircraft can proceed to target and return.

★ *Target Winds* . . . Surface winds must be taken into consideration on dive bombing missions.

★ *Runway Temperatures* . . . The ambient temperature is all important in jet operation.

★ *Freezing Level* . . . Glaze and rime ice are of lesser importance to jet aircraft due to their high cruising altitude.

★ *Altimeter Setting* . . . A forecast altimeter setting is essential for safe flight.

★ *Trail Levels* . . . Condensation trail levels are important for security reasons.

★ *Tropopause* . . . The tropopause has the same effect at altitude that an inversion has near the surface.

★ *Turbulence* . . . What may be a slight bump in a C-47 becomes severe turbulence at 500 mph.

★ *Alternates* . . . In doubtful weather, two or three alternates should be given, with fuel as one of the primary considerations.

**To aid in making a safe IFR flight check your base weatherman for the complete picture of conditions aloft.**

the latest altimeter setting is available, but a great change is possible over a distance of 400 miles, and a forecast altimeter setting is essential for safety. This is particularly true when the letdown is made in mountainous terrain.

Inherent error in the altimeter at high speed is a new problem. Here is a simple method for compensation that should be borne in mind. For every mile per hour increase of airspeed above 200 mph, the altimeter will indicate one foot too high. In other words, at 600 mph the aircraft will be 400 feet lower than the altimeter reading.

### Tropopause

The Tropopause has the same effect at altitude that an inversion does near the surface. Above the Tropopause the visibility is unlimited, while below it the forward visibility is often limited by heavy haze layers or a thin deck of cirrus. Every rated man has topped a smoke, haze or fog layer into a clear sky, and this is the feeling when passing through the Tropopause. With present jet aircraft flight above the Tropopause is impossible during the summer months because of the height at which it is located.

In the winter months the Tropopause is located well below maximum operational altitude. Turbulence at the Tropopause varies from light to severe, but the smooth unrestricted flight above is the reason for cruising well upstairs.

### Turbulence

Areas of turbulence are important because of the high rate of speed of jet aircraft. An area of light bumpiness in a C-47 traveling 160 mph becomes severe turbulence when encountered at 500 mph. Consequently, the pilot should know about those areas in which turbulence may be encountered.

### Jet Streams

Here is a phenomenon that a weather officer with only a surface and 700 millibar chart is powerless to locate. A full complement of constant pressure charts is a necessity. When no facsimile charts of the 500, 300 and 200 millibar levels are available, a call to weather central is the best solution. The reason for locating the jet stream becomes apparent when one realizes that it is strictly a one way aid and must be avoided when traveling in the opposite direction. Aircraft flying against the jet stream have been forced to jettison their ordnance before reaching the target.

Here's a good tip for the pilot. If he finds that he is five minutes or more behind on his navigational check points, he should descend a thousand feet and recompute his groundspeed. Possibly he has been bucking the jet stream and really spinning his wheels. Luckily, this phenomenon is a problem of concern only from the latter part of October through April. It is usually of little consequence the remainder of the year.

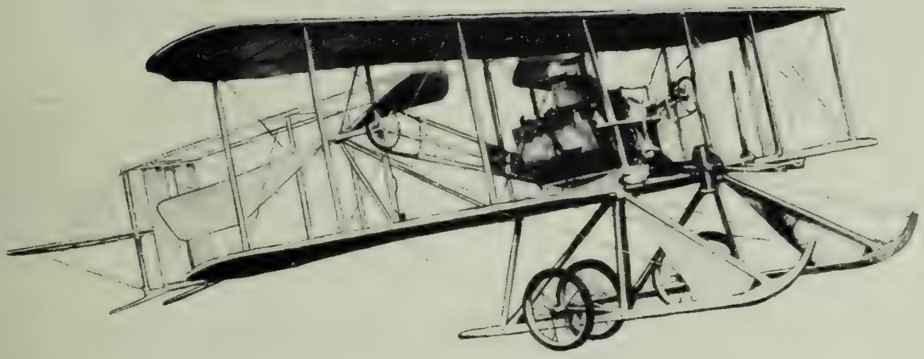
### Alternates

In periods of doubtful weather two or three alternates should be given. The operations officer will take the weather into consideration when planning the mission and add enough fuel for a margin of safety. Jets are unable to proceed to an alternate after the letdown is completed because of limited fuel supply. They must be notified that the alternate is to be used before a letdown is started.

All things considered, one of the most difficult problems facing the staff weather officer is gaining the confidence of the personnel he is serving.

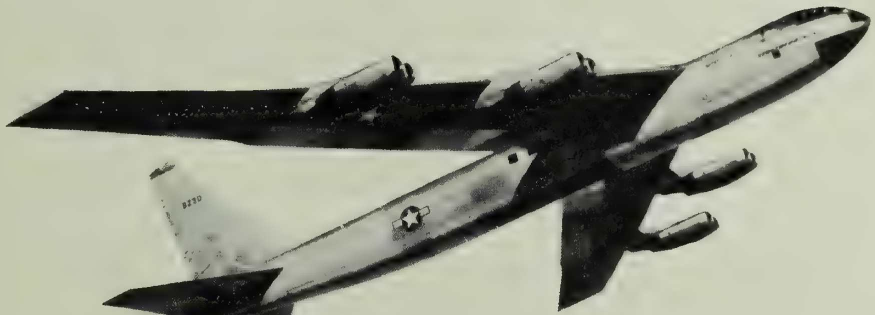
The rated forecaster who is also a jet pilot will find this much easier. He is able to understand the problems of a jet pilot and can present the briefing with these problems in mind.

In the interest of greater safety, the importance of weather actually encountered should be discussed with each member of a returning flight. Although the majority of pilots are experienced and give reliable reports, a more accurate picture of the weather en route and return could be given in many instances. No two men see the same thing. Careful analysis and correlation of reports on the part of the forecaster will aid immeasurably in planning subsequent flights.



# 50 YEARS OF POWERED FLIGHT

Aviation stands on the threshold of a golden age. The next 50 years will see advancements and developments even greater and more rapid than those of the past. Safety must remain an inherent part of our future.



## For a Merry Christmas . . Fly Safely

THIS is the threshold of the 1953 holiday season. Christmas wil soon be here and thousands of service personnel will be goin home for the holidays.

As an Air Force pilot, a tremendous responsibility rests on you shoulders—whenever you fly, whatever the season. But during th coming holidays, when you are likely to be transporting many traveling servicemen, we enjoin you to be doubly cautious.

Remember AFR 60-1, which prohibits flight solely for the convenience of individuals or groups After a flight is scheduled, remember your responsibility, both to your passengers and to yourself Plan your flight. Fly your plan. Fly safely.

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# FLYING SAFETY

UNITED STATES AIR FORCE

JANUARY 1954

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**In This Issue**

- Flying a Mountain Wave
- Looking Over the T-29D

# FLYING SAFETY

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**VOLUME TEN**
**NUMBER ONE**

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Photographs used in the Mountain Wave story were taken by the U. S. Navy, Mr. R. Symons and Mr. K. E. Oevgard.

A Raydist Station recording an account of a glider flight. Story is on page 21.

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## SUBSCRIPTIONS

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★ ★ ★

The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payment can be made for manuscripts submitted for publication in FLYING SAFETY magazine. Contributions are welcome as are comments and criticisms. Address all correspondence to the Editor, FLYING SAFETY magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Non-Air Force organizations must query the Editor before reprinting, indicating how the material will be used. The contents of this magazine are informational and should not be construed as regulations, Technical Orders or directives unless so stated.

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# ARTC
# CONFERENCE

TOP staff officers and representatives of all divisions of Air Training Command met recently with the Deputy Inspector General and key personnel in the Directorate of Flight Safety Research to evaluate flight safety problems. In his welcoming address, Maj. Gen. V. E. Bertrandias, Deputy Inspector General, emphasized the ever-increasing difficulties of adapting human capabilities to technical advancement. He stated that although the accident rate has been reduced from 29 per 100,000 flying hours in 1952 to 24 per 100,000 hours for the first nine months of 1953—the lowest rate in Air Force history—no opportunity should be missed to improve the trend. General Bertrandias stressed that it is within the human factors, in maintenance or in the air, that lives and defense dollars can be saved.

A detailed breakdown of USAF accidents by aircraft type, command, flying situations and other criteria was explained by Brig. Gen. R. J. O'Keefe, Director of Flight Safety Research. He elaborated on the loss to the Air Force in terms of crews and dollars and pointed out the specific problem areas that offer the greatest opportunity for safety effort. Among them were takeoffs and landings, transition training and variations in configuration in relation to flight characteristics.

Maj. Gen. G. O. Barcus, Vice Commander of ATRC, keynoted the conference when he stated that the ultimate USAF goal is to eliminate every possible accident in order to continue to reduce the cost of training without loss of efficiency.

Norton Air Force Base was chosen for the three-day conference because the Directorate of Flight Safety Research, Office of The Inspector General, USAF, has prime responsibility for aircraft accident investigation and is the repository for all aircraft accident records.

The major purpose of this symposium was to:

1. Familiarize ATRC representatives with the facilities and assistance available through the Office of The Inspector General at Norton AFB.
2. Further the general knowledge of individual Flight Safety officers assigned to the Air Training Command.
3. Standardize Flight Safety officers' procedures in the conduct of their duties.
4. Present specific flight safety problems and, in panel discussions, recommend corrective action.
5. Discuss with the aircraft manufacturers the characteristics of their equipment in terms of the ARTC safety program.

Particularly interesting to the conferees were the discussions conducted by test pilots of the aircraft industry. The design and manufacture of aircraft and the training of people to fly them are the most fundamental areas for study in the entire field of flight safety development. It is therefore imperative that test results, flying techniques and training methods be reviewed mutually and the results pointed toward complete accident prevention.

Lockheed, North American and Republic were represented by Tony LaVier, Joe Lynch, and Jack Bade and Carl Bellinger, respectively.

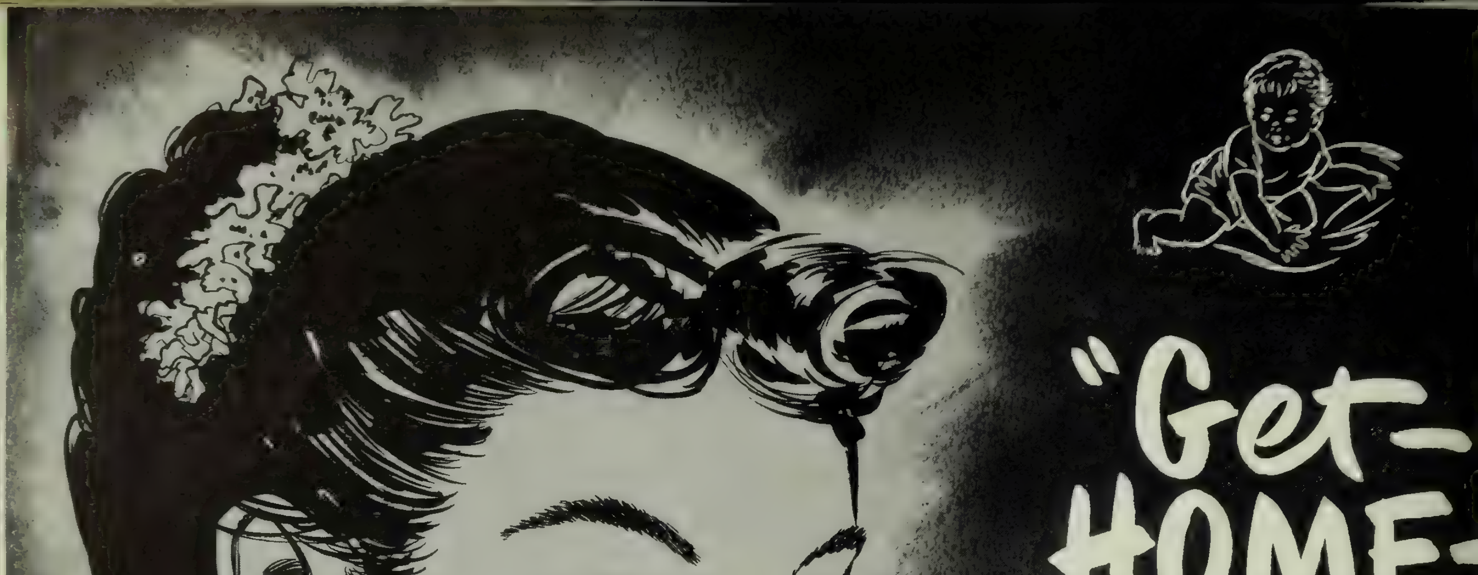
Tony LaVier briefly traced the history of jet aircraft and expressed his appreciation of the difficulties encountered in transition from reciprocal to jet flight. Highlights of his talk included Lockheed's pioneering in jet flight production. In the ensuing discussion he provided experienced advice on spin characteristics in various configurations, fuel control, maintenance requirements and recommended approach patterns.

Speaking of the F-86D and F-86F, Joe Lynch of North American described design and construction developments necessary for high speed stability. He made specific reference to low altitude flying characteristics and re-emphasized the general tendency of inexperienced pilots to overcontrol all jet aircraft.

All industry test pilots emphasized the attention which must be given to proper landing approach patterns.

The Republic representatives, Jack Bade and Carl Bellinger, spoke in detail of the F-84F and F-84G, pinpointing specific handling characteristics, theoretical and proven capabilities, and idiosyncracies. Pitch tendency, aileron reaction, stall warnings and flight limitations, "artificial" feel of boost systems . . . the personality as well as the characteristics of aircraft were introduced by these test pilots who live with them under every conceivable circumstance.

Following the background talks the members, in panel groups, studied the specific problem areas and from their recommendations will come changes in the use of check lists, revised programs of transition training, greater utilization of training schedules, increased use of safety education material and changes in flying doctrine, particularly as it concerns spin recovery and landing approach techniques. *All pointed to your greater safety.* ●



# "Get– HOME- itis!"

**This malady can cause much d tress. Fortunately there's an an dote, composed of little more th common sense.**

*JANUARY is traditionally the time of the year to take stock. You add up your assets and sigh with satisfaction. Then you count up your liabilities and determine how to turn them into assets. Before you take stock around your rose-covered cottage, you might read this piece on attitudes. An attitude is a little difficult to put your finger on. But it can be an important asset on your list — or a grave liability.*

There's a song the husky-voiced gals still sing once in a while in the cabarets. You've heard it wafted over the smoky air, to the accompaniment of a real blue piano. The first line goes, "For every man there's a woman."

At first thought the application to flight safety might appear a little remote. Well, a quick survey of your friends, neighbors and comrades in arms will bring to light a fact you very likely have noticed already — for every man there *is* a woman. A wife, a mother, or a girl whose phone number comes to mind without consulting the directory. And if you're an Air Force pilot, the lady in question can have a good deal to do with our favorite subject, flight safety.

A lot of things go into determining safety in flight. The design of the airplane and equipment. The skills of the myriad of people who have a hand in getting the plane into the air. Your own proficiency as a pilot. All of these factors are rigidly controlled by the Air Force. But there is one factor the Air Force can't control — your attitude toward a particular flight. That's where the ladies come in.

Feminine relatives sometimes cause pilots to suffer from a malady known as "get-home-itis." You've never seen it in the statistical reports, but it causes airplane accidents. The pilot worried with it will do a lot of crazy things he wouldn't ordinarily do. Like flying the worst route home if it happens to be the shortest one. Like taking off for home when he's bushed and should have RON'd. Like attempting a landing at the home base when the visibility is so bad he can't see the runway anyplace but in his mind's eye.

All of these things are the result of "get-home-itis." "Get home for dinner." "Get home on time because we're playing bridge." "Get home early because we have to see the third grade play at school tonight."

Right here we should get one thing straight. Although the lady at your house may have started the "get-home-itis" attitude, the fault lies with you. You are the one who has formed her attitude toward your job. You are aware that flying today is a highly demanding profession, that it sometimes requires every bit of skill and concentration at your command, and that it is unforgiving of carelessness and mistakes. But does your wife realize that? In very plain words, does she know that your attitude toward a flight may mean the difference between a long career and a mighty short one?

At the risk of belaboring the point, we're going to tell you a little story. We told it once before in FLYING SAFETY, about six years ago. It isn't a true story, yet we think that similar things have actually happened. It goes like this.

Once upon a time there was a B-25 pilot. Lawrence Bates, Capt. USAF. He was weathered in at a base in Tennessee. And he wanted to get out.

Captain Bates stood in the door of operations and watched the flakes settling on the eight-inch layer of snow already spread over the ground by two days of intermittent snow and sleet. His gaze went from the sky to the flight line where his B-25 was parked. Snow was accumulating on the wings although the crew chief had just finished brushing them off.

Larry crushed his half-smoked cigarette and stamped back into the weather office to continue his vigil at the teletype machines. For two days now his face had been a mirror for the sequence reports.

Only one plane had been cleared eastward since the Captain had been grounded at this Tennessee field. It had quickly returned to the base, covered with ice, the pilot vociferously grateful for having his feet back on the ground. But Larry badgered him with questions about the attempted flight. Any forward visibility? Windshield ice up? De-icers do any good? What was the temperature up there?

Finally the pilot told him, "Look Captain, if you're thinking of clearing through this stuff you're nuts. This is the worst weather I've ever flown in, and I've flown in some rough stuff."

But so had Captain Bates. He had flown many a trip from India to China and back, and no one could deny the weather over the Himalayas could get pretty lousy.

Just then an ETA came in on a C-54 coming in from Langley Field, Larry's home base. He listened over the squawk box to the pilot's reports over various stations along the route. "Heavy icing over Richmond. Extreme turbulence over the mountains. Snow and ice over Tri-City. De-icers only partially effective."

Larry sat and muttered. "Why did this have to happen to me? Janice told me to be sure and get home for the colonel's party tonight. What will I tell her? She'll never believe I was grounded because of weather. She knows I'm considered a very good instrument pilot." He recalled the painful ordeal he went through last time he was a day late getting home. This time it would be worse.

When the C-54 landed and the pilot walked into operations, Larry was waiting for him. The pilot's reports were not quite as bad as he had expected. He could make it home! He had de-icing equipment and there was no reason why the operations officer shouldn't clear him.

The operations officer, who had heard Larry's tale of woe too many times already, looked dubiously at the clearance. "Do you really feel that you can make it?"

The Captain assured him that the B-25 could get to Langley easily, no sweat. So the operations officer signed the clearance. With his copilot and crew-chief in tow, Larry raced out to the airplane.

After receiving several advisory messages from Flight Service, he was cleared for takeoff. At 600 feet they were in the clouds. Ice began to build up almost immediately. The Captain let it build up on the wings. When he thought it no longer safe to wait, he started the boots pulsating. The ice cracked and flew off. He smiled to himself and let it build up again.

This time, however, it collected much faster, almost as soon as the boots were turned off. Soon he could no longer see through the windshield, and airspeed started decreasing. He checked the pitot heater quickly. It was on. He turned on the prop de-icers and the airspeed started building up. The copilot, unimpressed, glanced around at the crew chief.

Over the foothills, turbulence set in. Icing conditions were getting worse, and the de-icing boots would no longer clear the wings. Although the Captain was now pulling 40 inches manifold pressure and using 2300 rpm, the airspeed was decreasing steadily.

As the airspeed went down to 150 mph, the copilot took up all the slack in his chute harness. Turbulence made it almost impossible to keep the plane upright. The gyro instruments had spilled twice. Airspeed was down to 130, then 120, 110, full power and rpm's. A quick picture of Janice, dressed and waiting, flashed through the Captain's mind as he told the crew, "Prepare to bail out."

That was all the crew chief needed. He dumped the hatch and out he went. The altimeter read 5500 feet as the copilot left the plane. Almost as soon as his parachute opened, his feet touched the ground.

A few hours later, a rescue party found the B-25 lying in a snow-covered meadow, Captain Bates still in the cockpit. Fortunately the B-25 struck on a gentle upslope and although the plane was almost completely demolished, the pilot survived.

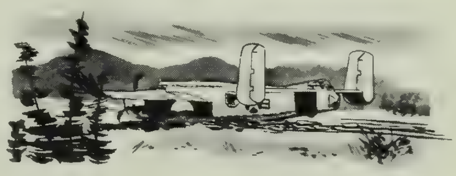
If this were a true story, it would have gone down on the statistical reports as "Cause Factor: Weather." But the real cause was that attitude we were talking about — "get-home-itis."

The Captain's wife would never have believed the crash was the result of anything but ice and snow. Why should she? She was interested in her husband's career. She saw that he ate the right foods, had a comfortable home, got enough rest. Probably she assumed a lot of the household duties she would have expected her husband to take care of, had he worked at a more conventional occupation. She didn't think it was too much to expect him to be home in time for just one special occasion. But it was.

We don't think "get-home-itis" has reached epidemic proportions. And we think Air Force wives are pretty intelligent gals who know the importance of your job. But if the "get-home-itis" attitude prevails around your house, fold this issue of FLYING SAFETY open to these pages and put it on the coffee table.

Remember, you may not be as lucky as our fictitious Captain Bates.

Don't make one flight for home your last flight — for anywhere. ●



# an airline pilot looks at SAFETY

**Reprinted from COMBAT CREW Magazine**
**Hq Strategic Air Command, Offutt AFB, Nebr.**
**Oct. 1953**

**By Captain Robert N. Buck**
**Trans World Airlines**

IT was one of those beautiful moonlit nights and I was sitting at 19,000 feet well on top of a strato-cu deck headed for Paris. There wasn't much to do except the endless chore of airmen the world over, which is to wait for the clock to go around. When the wind is with you, destination CAVU, lots of gasoline in the tanks and the needle pointing straight ahead, there isn't much to do or think about and you can daydream as you stare into that great vastness of the sky. Of course, you daydream like a dog does in front of the fire, knowing you'll come out of it when some strange noise or suspicion enters your peaceful world. As a fellow once said: "Flying is made up of hours of boredom broken by occasional moments of stark terror."

Well, I was in the long hours and sort of daydreaming; the subject I kept focusing on was the exciting moments in the past 24 years of flying airplanes of various sorts to various places. How many chills and thrills had I experienced? Well, not too many, really. There was the time I had about two hours solo, couldn't get out of a spin and rotated a Fleet from 4000 feet down to about 900, where straight luck got me out. And there was the time I was in a cross-country air race, flying about 50 feet over Texas, and passed another airplane way off to one side. I put a pair of binoculars to my eyes to read this guy's race number, didn't pay enough attention and flew right into the ground. The ground—praise the Lord!—was level and I zoomed away from it without a dent.

There was also the time I got stuck on top of some clouds before I knew how to fly instruments and had a hard, dry lump in my throat for quite a while before I was lucky enough to find a hole and get down through it.

But those were all stupid things, I reasoned to myself. How about the close ones that weren't your fault? How about engines quitting and things like that?

Well of course, I had a few in single-engine airplanes way back when, but you expected them in those days and weren't disappointed as you generally had a field ready most of the time. Besides, airplanes landed slowly then and any old patch of ground was good enough.

The first narrow escape I had in an airplane was in a DC-2 right over an airport. I had a few in DC-3s too, but I feathered and got home—worried, of course, but okay. Paddled along about 600 miles in a B-17 on three, but it went like the book and there was no sweat. There was one incident last summer, right on takeoff in a Connie, at Rome, when number four digested a piston. We were well past unstick speed when it happened, so we went through the act as it is set up in the manual, circled the field and landed.

There was that fire warning at 18,000 feet indicating a cargo compartment fire. We got depressurized, made a fast descent and went on oxygen in the routine manner. It turned out to be a false alarm.

And I daydreamed about the thrills in weather, which, after all, is still about the biggest problem to face. The incident which stands out most, however, is the time—long after I'd been an airline pilot—that I

borrowed a little ship for a flight from New York to Scranton, Pa., to see my mother on Mother's Day. I wanted to get there in the worst way and kept poking into weather that good sense should have told me to keep out of. I wound up doing about 40 minutes on the primary flight group in rough air. Brother, that wasn't in the fun department.

There were also a few times I wished I'd had more gasoline when the destination went zero zero, so I've been real fussy about gasoline ever since.

And, there were a few thrills in thunderstorms. But I've learned and am convinced that if you slow her down, maintain attitude and airspeed, and to hell with altitude, you'll finally stumble out the other side in one piece. All the serious trouble I've seen around thunderstorms has been from hitting them too fast. Naturally you try to stay out of thunderstorms as much as possible.

And through this daydreaming I began wondering what one thing I could pick out that was the greatest danger. Was it engine failure? Ice? Thunderstorms? Or what? And it dawned on me, rather abruptly, that the greatest danger had always been myself. That most all the tangible thrills I'd had were brought on by goofing off in one form or another. Of the other type troubles—engine failures, etc., proper knowledge of the right thing to do turned them into almost routine incidents.

### Why Goof Off?

So, it seems that if I goof off, there may be trouble, and if I don't, there isn't. Then why goof off? None of us have ever done it on purpose. Then why do we goof off at all? The answer that crops up is complacency. If we are smug and complacent, we are on the verge of trouble.

There are various types of complacency, and different places in which it shows up. A simple kind is when we tune the radio compass to a station, are just about on the frequency and the needle points ahead briskly. We say, "That's it!", but never bother to identify it. The other end of the scale is when we don't thoroughly learn emergency procedures. We think we know them, or the basic information, and feel that when an emergency occurs, we can out-think it. Well, of course, we can't out-think a quick happening. We can move faster than we can think, and in a fast moving emergency we may move too fast and do the wrong thing. On the other hand, if we know the book by heart, we still may move too fast but we'll probably do the right thing instinctively.

**A veteran of 17 years with Trans World Airlines, Capt. Robert S. Buck first soloed in a homemade glider in 1929. The following year he switched to power airplanes, and from 1930-37 tried his hand at racing, instructing and barnstorming. He became a TWA captain in 1940. During the war he flew for ATC, piloted a B-17 on a global precipitation static research project and poked into thunderstorms in a P-61. Since 1947 he has again been flying as captain on TWA international routes.**

Capt. Buck believes that the greatest danger to a pilot is complacency.

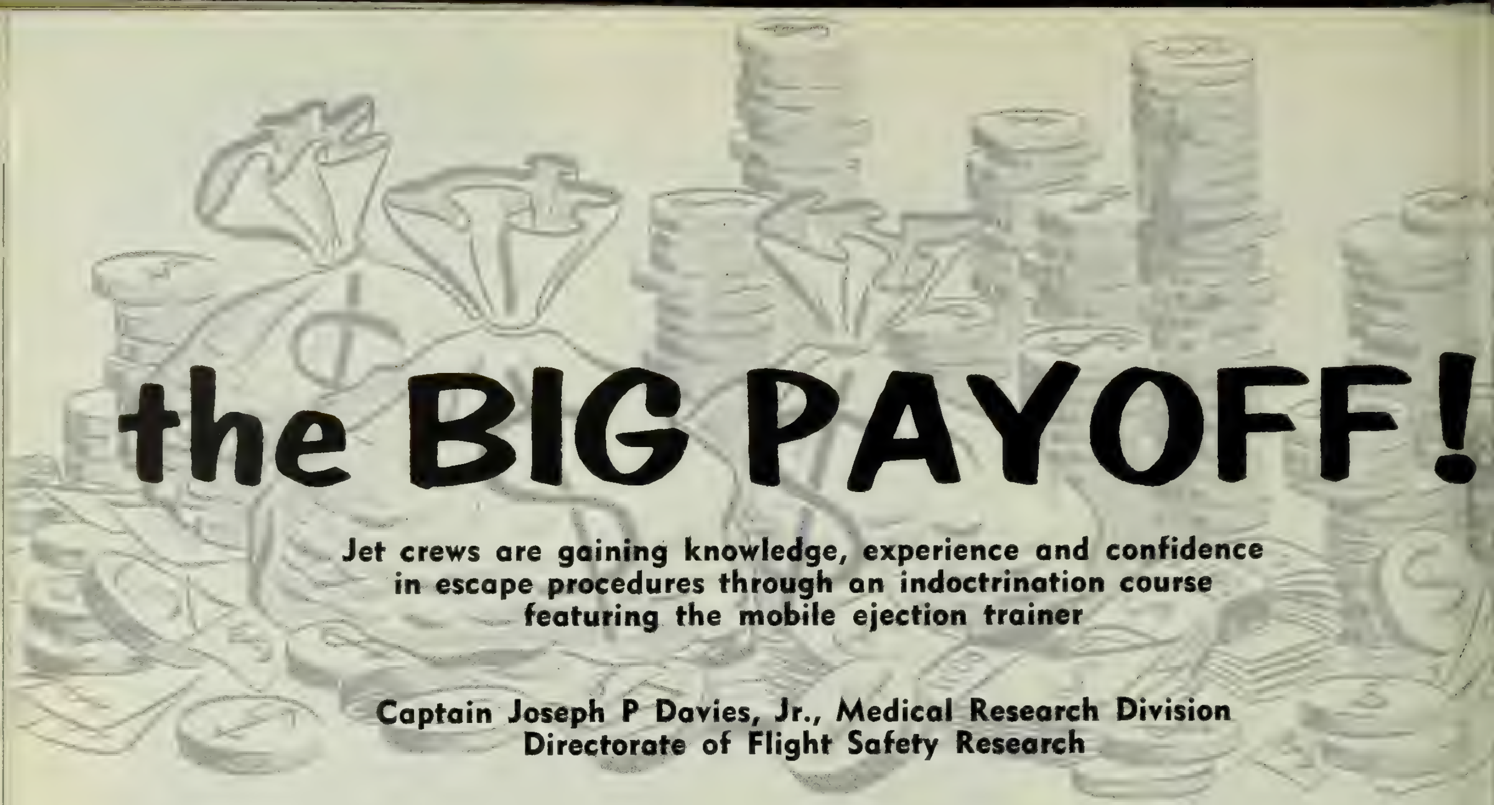
We can get complacent in the air from fatigue, and must guard against it. If we are tired or need oxygen, we may get complacent about identifying the station we tuned in or just take too many things for granted.

The other type of complacency, such as not bothering to know procedures well enough, is difficult to comprehend. We all have some of it to a certain degree, and it's a battle to keep it under control.

The first sign of complacency came after my solo, and I went through the first cocky stage thinking, "I'm a pretty hot pilot." Then, of course, something scared me and I quit being so red hot. In that same feeling, or something like it, comes advanced complacency.

Personally, when I get to feeling a little smug about how I know all the answers, a red flare goes up saying: "Take care, brother, you're about to trip over something!"

And so this session of daydreaming seems to bring out that the greatest danger is myself in a complacent mood. And speaking of complacency — "Engineer, how much gasoline have we left? Navigator, where are we? What's our ETA and can both of you prove it?" ●



# the BIG PAYOFF!

### Jet crews are gaining knowledge, experience and confidence in escape procedures through an indoctrination course featuring the mobile ejection trainer

**Captain Joseph P Davies, Jr., Medical Research Division**
**Directorate of Flight Safety Research**

IN the interest of greater safety through knowledge, the original ejection trainer, located at Williams Air Force Base, was utilized as a basic pattern for a completely mobile ejection seat training unit. This new model has a simulated cockpit in place of the original open-air boom bucket and the old 102-foot rocket launching tower has evolved into a 21-foot collapsible track which can be airlifted.

In short order several copies of the new mobile ejection seat trainer had travelling fever. And the jet pilots in FEAF, Alaska and Europe were soon joining the graduate club in mounting numbers.

The author had the privilege of giving ejection seat indoctrination to pilots in the FEAF area, where training was conducted in turn at Johnson Air Force Base in Japan, Kadena Air Base on Okinawa and K-2 in Korea.

One major purpose guided the mobile ejection seat training program: Impart knowledge and experience to the crewmember which would insure his successful escape from an airborne jet aircraft.

To accomplish this purpose, the indoctrination course included both a lecture period and a practice ejection. The lectures to FEAF personnel included the latest information on seat ejection and emphasized the review of actual emergency ejections and specific difficulties encountered.

The practice ejection, which climaxed the course was designed to accomplish two things: First, it acted as a review of ejection procedures in a simulated cockpit. Second, it gave each student the actual physical sensation of an ejection, excluding of course, the effects of windblast and tumbling.

It is significant that while many pilots did not like the idea of getting a large slam applied in 15/100ths of a second, most thought there was little or nothing to it after experiencing the practice ejection.

The indoctrination program emphasized the major factors incident to successful ejection. Of course the first requisite is to know thoroughly one exact ejection procedure for one's particular aircraft. However, there are two rules which, if followed closely, greatly enhance the chances for successful ejection from any aircraft.

In order of importance, they are:

*Eject While Sufficient Altitude is Still Available—*

Studies on file in the Directorate of Flight Safety Research show conclusively that below 2000 feet, and particularly below 1000 feet, the chances for successful ejection from jet aircraft decrease very rapidly. Actually the chances for safe ejection between 1000 and 2000 feet are fairly good, but only *if the aircraft is near a level attitude.* However, a pilot who remains with an aircraft in a 600 mph steep angle dive will contact the ground from an indicated 10,000 feet in less than ten seconds. When the factors of ground elevation, altimeter lag, reaction time, and possible delays caused by "G" forces and other difficulties are considered, the advisability of leaving the aircraft at a reasonable altitude is obvious.

*Separate From The Seat As Soon As Possible After Ejecting—*

Men who have had experience on the ejection seat trainer will verify the fact that there is a small time delay between the time of firing and the recovery of your full capabilities. Even with a reminder just prior to ejection, many men have ridden the seat back down the track to a stop without unfastening the safety belt.

Couple this with the following facts:

★ Most men who free fall do not experience the usual sensation of falling, and therefore the time element in separating from the seat does not assume sufficient importance.

★ Sometimes it is not easy to unfasten the safety belt (due to wind and tumbling, etc.).

★ There is an almost *innate urge* to pull the ripcord first.

★ There is a great advantage in separating from the seat during the horizontal portion of the ejection trajectory in order to prevent possible injury caused by the seat falling into you or your parachute.

From the above it can be determined that immediate separation from the seat is important and that particularly at lower altitudes and *higher downward speeds* the procedure must be like clockwork. Consideration of these factors led to the development of the automatic lap belt release. Also, present SOP states that the safety belt will be unfastened prior to ejection below 2000 feet if proper body position in the seat can be maintained.

Another vital factor in many emergencies is the problem of fear. Fear is a possibility in any emergency. However, even when fear is present, difficulties can and must be evaluated so that positive remedial action may be taken.

The stories of panic are many. Recently a man's "D" ring was hooked over his parachute harness in such a manner that the conventional method of pulling the "D" ring did not work. Had he recognized the source of his trouble, unhooked the "D" ring and then pulled, his bailout would have been successful.

In contrast here is part of the story of a pilot who ejected near K-2, Korea, during August 1953.

After ejection, his helmet was twisted around on his head so that he couldn't see and had difficulty getting his safety belt unfastened. Although he thought he pushed the seat away with his feet, when he pulled the "D" ring, nothing happened. Then he pushed the seat away again and the parachute opened. All this was done by feel because of the twisted position of his helmet. Finally he got the helmet off and saw that the 'chute was twisted and also had several rips in it. Furthermore, the seat was caught in the shroud lines, spinning in the breeze and causing his canopy to get progressively smaller. Searching for a knife to cut the shroud lines and release the seat, he found two of his knives gone, and one unavailable. It was the fourth and last knife which saved the day. Just prior to landing he finally got the seat loose. In landing, his head hit a rock, but no injury resulted since he had kept his helmet between his knees and put it back on at the last moment !

Incidentally, this officer attended the mobile ejection seat training course the day prior to his emergency.

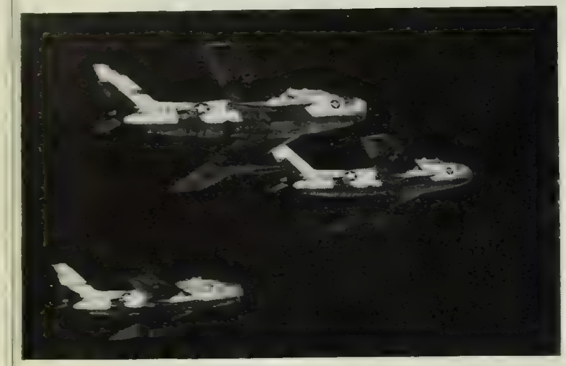
Ejection seat indoctrination is but one phase of survival and emergency escape training.

Following is the account of an emergency escape from an F-80C which indicates complete and thorough training of the pilot by his organization.

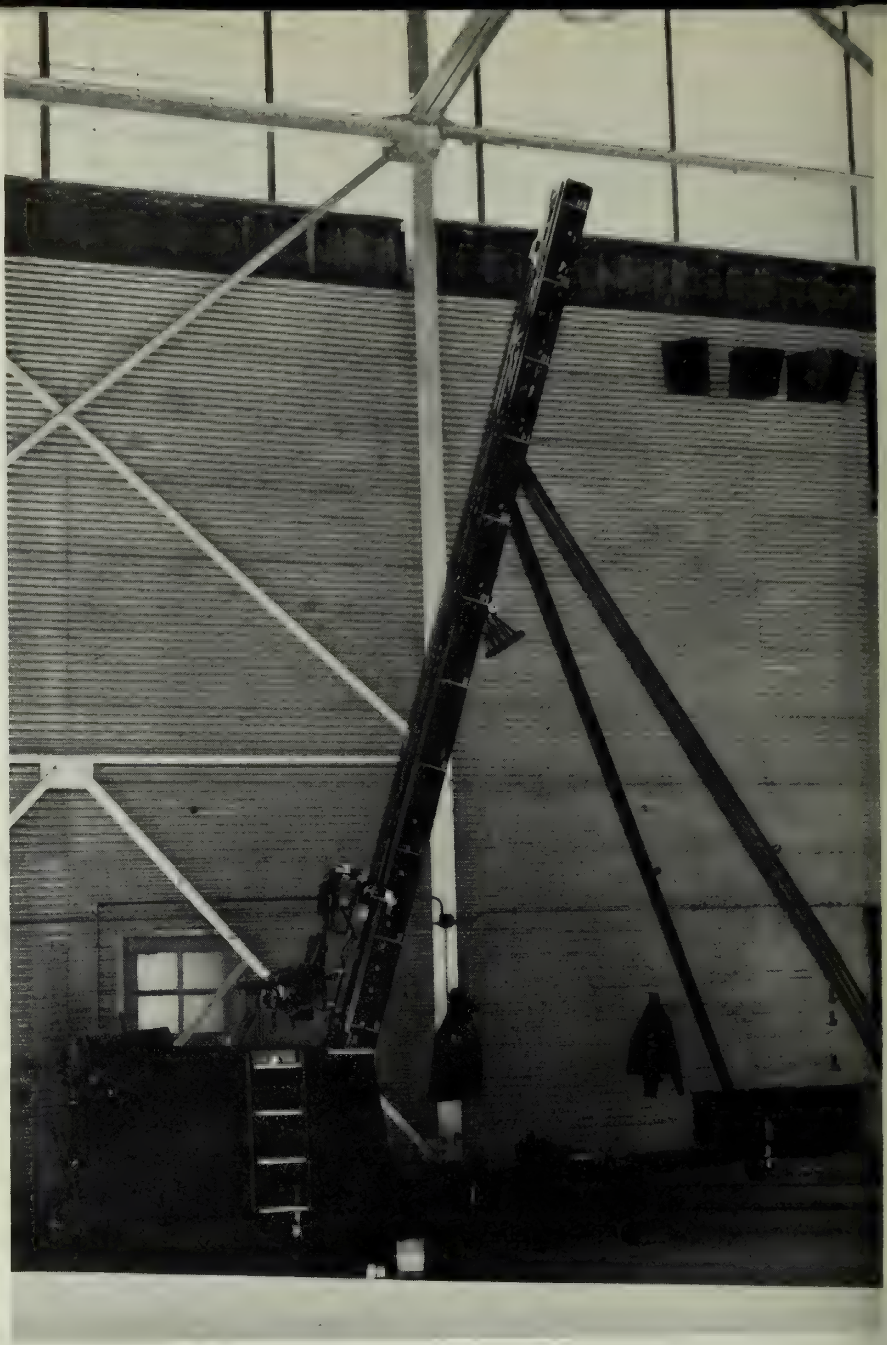
"I leaned forward, fired the canopy and placed my feet in the stirrups. As I leaned back I raised the armrests, and when my head touched the headrest I pulled the trigger. The entire operation seemed quite easy, automatic, and was accomplished very rapidly in a smooth uninterrupted motion. I would estimate that it took less than three seconds from my decision to eject until I cleared the aircraft. I had the feeling that I had done everything before. After clearing the aircraft I couldn't orient my position relative to the horizontal trajectory, but this didn't affect my releasing the seat and pulling the ripcord almost immediately.

"I attribute the success and ease with which I ejected and survived in the water afterwards in great part to the extensive and excellent survival training carried on in my squadron. All members of the squadron have recently been through an ejection seat tower ride and associated lectures. Also, within the last month we witnessed a demonstration of water survival at the beach which included actual use of dinghies, 'Mae Wests,' marker dye, flares, etc., and three

**Bottom, seat in firing position.** **Right, seat in safetied, loading position.**



**The first rule for safe ejection is to know the procedure for your aircraft.**



**The trainer accomplishes two things: It enables a student to review procedures and to feel the actual physical sensation of an ejection.**

actual jumps into the water just off shore from a C-47 by experienced parachutists to show the different ways of getting out of the harness and when to inflate the B-5 life preserver.

"The week of my accident, training was taking place at the base swimming pool. All rated personnel had to jump off the high board, get out of their parachute harness in the water, inflate their Mae West and climb into an overturned dinghy. The pool was also used to check out the new Mark IV exposure suits being issued to the squadron. I felt the fact that I was at home in the water and had a lot of swimming experience aided me after landing in the water. The squadron is now conducting a class in swimming for the less experienced swimmers. I have mentioned the above training because it was a great help to me when it came time to use it, and similar training might aid members of another squadron."

Remember, too, no bailout, ejection or conventional, is complete until you have landed safely. So be sure you are up on the latest techniques, particularly those pertaining to water landings. Make the necessary preparations prior to water contact and don't get out of your parachute until you touch the water.

Another pilot who completed the FEAF ejection seat training course at K-2 states, "The indoctrination program helped me tremendously in making a successful ejection without injury. I unfastened my chest strap while still in the air and released my leg straps successfully after hitting the water. Once while descending, I judged myself to be only a few feet from the water. I dropped my helmet more properly to judge my altitude and *it disappeared before striking the water,* again emphasizing the fact that it is impossible to judge your height above water!"

Training in survival and emergency escape does pay off — in a "big way." Shares are cheap; the dividends are enormous. So how about getting hold of some stock in the mutual fund? ●

# WELL DONE!

**Captain Charles H. Proctor**

**Captain Kermit E. Spears**

By making nine "saves" over a period of two years, Captains Proctor and Spears have prevented a loss to the USAF of over two million dollars in drone aircraft and equipment. Proctor and Spears recovered these shot-up, damaged or malfunctioning drones on the Salt Flats area in New Mexico.

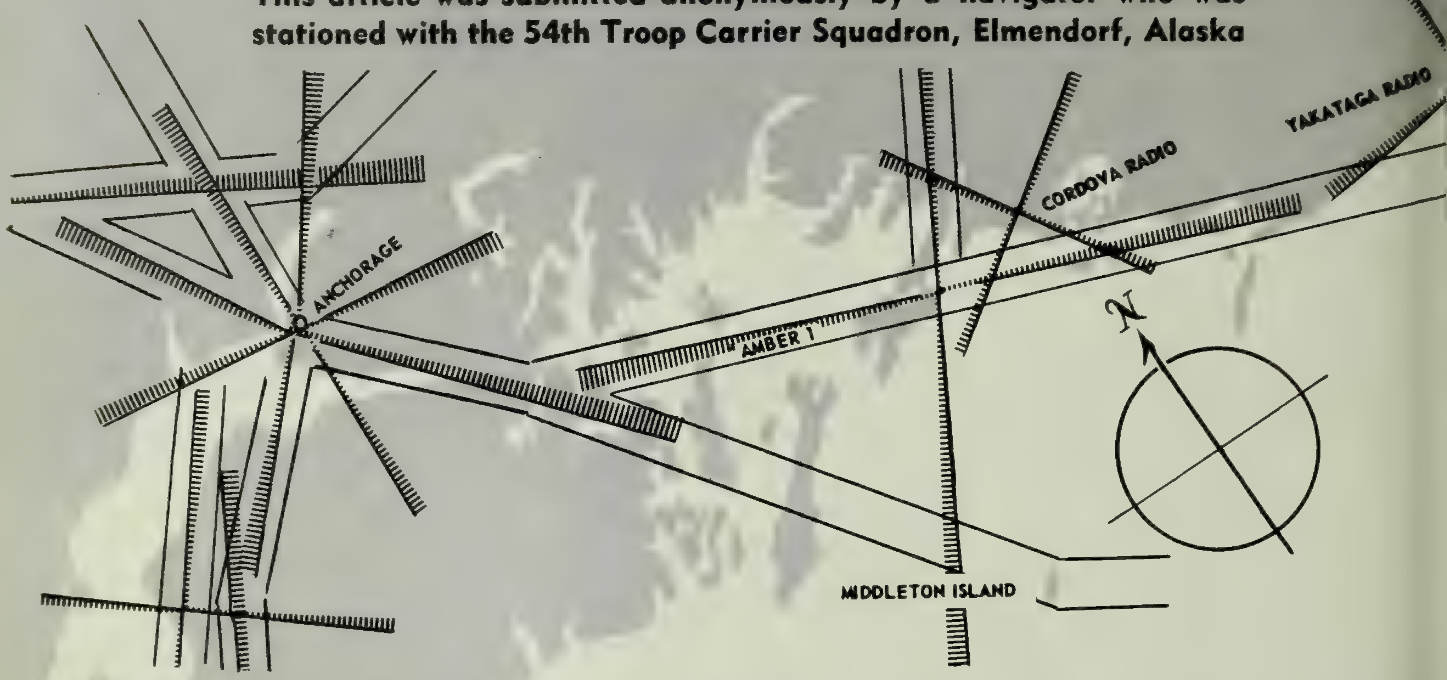
They elected to utilize the Salt Flats area for the recovery to preclude endangering lives and property in the vicinity of Holloman AFB, home station of the drone unit. Especially noteworthy is the fact that all recoveries were accomplished by remote control from a director B-17 flying formation with the nullo (unmanned) drones.

This technique in making the recoveries was developed by necessity as each situation arose, since training in landing drone aircraft is not received by remote control pilots. The way these pilots handled each emergency reflects favorably on their skill and practice in all phases of drone operation.

To Captains Proctor and Spears for their fine work in preventing loss of lives and property and in saving needed defense dollars, Well Done.

# Foul Wind at Fairweather

**This article was submitted anonymously by a navigator who was stationed with the 54th Troop Carrier Squadron, Elmendorf, Alaska**



IN 1949 one of our C-54s was reported missing. It was found at the 9000-foot level of Mt. Crillon in Fairweather Mountains between Sitka and Yakutat, Alaska. The accident was attributed to navigational error, probably induced by inaccurate or split beam legs.

In 1950 a Canadian Pacific C-54 was reported missing and to date has not been found.

A few days later a General Airways C-46 was reported missing and was found approximately two miles east of our C-54.

After the accident in 1949 navigators were assigned to the 54th Troop Carrier and an intensive proficiency program was inaugurated. At the time of the two 1950 accidents probable tragedy was averted on nine separate flights and a new theory was developed. The navigational aids were found to be as accurate as those any place in the world. However, who could believe that an aircraft could move from an area where the known wind is 15 knots and within a matter of seconds at the same altitude encounter winds of 135 knots with no visible effects, no turbulence, just a smooth slide toward the Fairweather Mountains? But it was there.

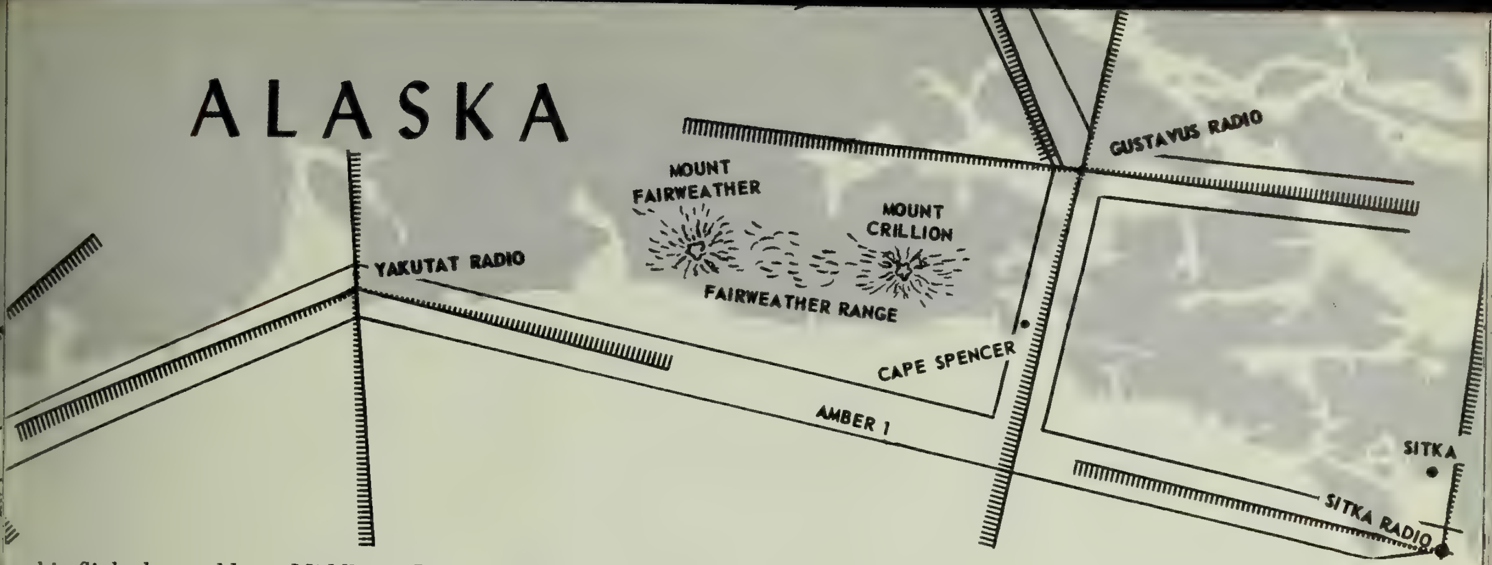
The first two incidents, two days prior to the disappearance of the Canadian Pacific C-54, were experienced by the squadron navigator who was directing an aircraft from Tacoma, Washington, to Elmendorf AFB, Alaska and by myself. I was 30 minutes ahead of the other aircraft en route from San Antonio to Elmendorf. Both flights were beautiful and uneventful until approximately 100 miles south of Middleton Island. Our maximum wind velocity encountered to that point was 15 knots, and groundspeed had settled down to where a good ETA on Middleton was practically a certainty. From a distance of about 120 miles the beacon at Middleton could be seen through breaks in the clouds and was dead ahead. Naturally, I sat back prepared to ride my ETA to Middleton.

Then it happened! The weather closed in, but still I saw no problems. Middleton was dead ahead and we had a good groundspeed — had it made. The intensive program of proficiency we had gone through, however, resulted in an automatic desire to stay busy, so five minutes after entering the weather I took a fix and found that I was five miles farther to the right than I had anticipated. I took a verifying fix within a minute and found that I was seven miles to the right. I called for a 15-degree correction to the left, which was questioned by the pilot, since he too had seen Middleton dead ahead. While the pilot was making the correction, I continued taking fixes and determined that the correction required, because of our rapid movement to the right, was approximately 45 degrees. I instructed the pilot and continued taking fixes until we reached not only Middleton Island but also Elmendorf, our destination. I found the "strong wind" corridor to be approximately 70 — 80 miles in width, and shortly before passing Middleton, we were back to our original 15 knots wind.

Upon arrival at Elmendorf, the squadron navigator and I compared logs, verified the unusual circumstances and determined that we must have been caught by the lower reaches of the jet stream which is know to exist in this area but which was believed to be at higher altitudes.

The next morning we had a navigators' "bull session." We informed the others of our experience and warned them to be especially watchful in that area.

The following week a navigator returning from Tacoma experienced winds in excess of 100 knots from a westerly direction in a 50-mile corridor between Sitka and Yakutat. On



this flight he could see Middleton Island and ascertained that a right drift of two to three miles per minute was a fact, and that a heading change of 40-degrees was necessary to arrive at Middleton.

A few days later another navigator experienced a similar wind in the same approximate corridor. Then followed a couple of weeks of normal flying, and again it happened. This time I was flying with a student on a route check to and from Tacoma. On the trip down, which was uneventful, I showed him the area to watch and cautioned him to be extremely careful. It paid off. On our return trip, we encountered a wind from 210°/112 knots and again used our 40-degree correction. This was not our last encounter with our "pet" wind, but that comes later.

While flying with the squadron operations officer, still another navigator caught a similar wind and corrected 40 degrees to Middleton Island.

Approximately two months later a pilot, with no navigator aboard, was returning from Tacoma via the coastal route (Amber 1). He crossed directly over Sitka and proceeded toward Cape Spencer. A short time out of Sitka the beam leg was lost and a distant "N" signal was heard. He turned left 15 degrees, then an additional 10 degrees, but the beam was not encountered as he had anticipated. The beam was still not encountered as he approached the NE-SW leg of the Gustavus beam, so as a safety measure he turned left 90 degrees and flew until the beam leg was crossed. This took 17 minutes on the new heading and shows that the distance right of course after the two corrections was approximately 30 to 50 miles. (Cape Spencer was the last reported position for the Canadian Pacific C-54 which vanished.)

Then our theory — which was checking out so nicely — exploded. On a return trip from Tacoma a student navigator flying a route check with me encountered a wind of 130 knots, but this time from 064 degrees. Our jet stream theory was out. What now?

I gathered all the information I could get from the navigators who had experienced it and proceeded to the weather office. The weather office had heard a few of our tales about the winds and had done a bit of research on his own.

Through the cooperative efforts of the 54th and the weather office we found that in the vicinity of Yakutat and Yakataga there is a persistent low pressure area, which at times develops winds in excess of 100 knots that influence the route between Anchorage and Seattle. A review of the weather maps and sequences on each date when the wind was encountered showed a deepening of the low pressure condition in this area. Armed with information, we devised a new route that would take us farther out over the water, where we would miss the low pressure area and the accompanying strong wind. As a result, a new SOP has been established.

If existing weather necessitates the use of Military Airways en route from Tacoma to Elmendorf and radio aids are lost at any time after passing the Sitka beam leg, an automatic change of heading 45 degrees to the seaward is taken and maintained until reliable Loran coverage ensures completion of the mission. This is done so that if the strong wind is present, the course to Middleton Island will be made good. If not, a course will be established toward the Homer Range, where Loran can be used to advantage. If the reciprocal strong wind is encountered, a course approximating Kodiak will be made good, and Loran can again be used to advantage. But in any case the 45-degree correction will keep the aircraft out of the area of excessively high mountains.

This SOP has been used to advantage. One of our C-54s lost all radio aids shortly after passing the Sitka beam leg and headed for Anchorage. Because of prior experience in this area by both pilot and navigator, the automatic 45-degree seaward correction was taken and Middleton Island was seen through a break in the clouds about five miles west of course. So the wind was there once more.

The 54th Navigator is not unaccustomed to winds in excess of 100 knots at 7000 to 9000 feet. These winds are quite prevalent in the Aleutians where the bulk of our flying is done. In most cases, dependent upon the pressure areas with which they are associated, their speeds rapidly increase, and their directions change from 100 to 180 degrees. These winds, however, have been reasonable and predictable. Therefore, it certainly jolted a few of us to find a completely alien wind of such magnitude, with no visible sign and no possibility of prediction. However, "our wind" was there — we found it — we recognized it — and I believe I can safely say that we exercised good judgment in overcoming it. Needless to say, we are cautious of it. We respect it, and we feel exceedingly lucky on trips where we don't find it. ●

# Keep Current

NEWS AND VIEWS

### Record Breaker

A Cessna XL-19B equipped with a high pressure demand type oxygen system and powered by a Boeing XT50-1 turbo-prop engine has flown to a new world's altitude record for light planes of 37,063 feet. This achievement has received official approval of the Federation Aeronautique Internationale, governing body for world aviation records. The former record for light planes was 30,203 feet.

Bill Thompson, chief engineering test pilot, took off in 90-plus degree heat for the record attempt. An hour and a half later and more than seven miles in the sky the outside temperature was minus 58 degrees Fahrenheit. Although windows and skylight were iced over, the new turbine still gave him a rate of climb better than 50 fpm! High tailpipe temperature caused Thompson to throttle back at 37,000 feet, experiencing an engine flameout immediately thereafter. He landed 45 minutes later with the new altitude figure recorded on a sealed barograph.

**The "Flying Barber Pole" configuration on the F-86D makes for quick identification in photos and by "chase" pilots.**

First light plane in the world to use turbo-prop power, the XL-19B differs from the standard Cessna "Bird Dog" Army observation plane only in its engine and accessories. It was pointed out that close to 125 pounds has been saved in engine weight, and although JP-4 military fuel was used for the record flight, the power plant will operate on anything from diesel fuel to high octane aviation gasoline.

The XL-19B development program is a joint project of the U. S. Army, U. S. Air Force, Cessna and Boeing.

### A Helping Hand

Although all of us are supposed to be completely familiar with the contents of the Radio Facility Charts, 'taint necessarily so, as evidenced by some of the choice ones that are pulled from time to time. Of course we have to admit that the constant changes that take place in the facility business make it difficult to stay current. But, remember, those changes are for the most part in your favor and a few spare minutes devoted to scanning through the latest editions of the Radio Facility Charts may well pay dividends.

Here's one wrinkle that is worth noting and pasting away in your mental file. It isn't necessarily a new item but you may have overlooked it in the past, so here we go quoting direct from the latest edition of the Radio Facility Charts:

"The Air Defense Radar Network can furnish emergency assistance to aircraft lost or in distress in ADIZ's and extended adjacent areas on an around-the-clock basis. These emergency procedures are supplementary to information now contained in Supplementary Flight Information, United States.

"As radar is restricted to line-of-sight coverage, altitude should be increased if necessary and possible before initiating procedures. Procedures should be repeated every 20 minutes until instructions are received or interception is accomplished.

"a. *With two-way radio:* Request radar assistance from the Air Defense System through any CAA range station or call Radar Control on 121.5 mc or 243.0 mc using distress calls of 'Mayday' or 'Pan'.

"b. *With receiver only:* Tune to 121.5 mc or 243.0 mc. Fly a *right* hand triangular pattern with two minute legs and one half needle width turns of 120°. Complete at least two patterns before resuming course. If radar contact is established, instructions will be given on 121.5 mc or 243.0 mc.

"c. *With no receiver:* Fly a *left* hand triangular pattern as above. If radar contact is established, a rescue aircraft will be dispatched for intercept. Resumption of course will not compromise this system as the aircraft will continue to be tracked or 'distressed' from point of initial contact."

### Duck Season

*To duck or not to duck; that is*
*the question.*
*Whether 'tis nobler in the mind*
*not to duck*
*And suffer the slings and arrows*
*of outrageous canopies,*
*Or to take arms against a sea*
*of troubles*
*And by ducking, end them? To*
*duck, to live,*
*And by doing so we end*
*The thousand Natural shocks*
*That heads are heir to.*
*'Tis a consummation devoutly*
*to be wished*
*That pilots stoutly will adhere*
*to*
*T.O.'s pertinent to their gear.*

"Pilot jettisoned canopy from his F-86A at 6000 feet but did not eject. Paint matching that on his P-3 helmet was found on the leading edge of the canopy."

Your head is fair game to a dishing canopy. The victory is seldom in dispute. Many canopies take a swipe at your noggin when they go, although most recent jet aircraft canopies are designed to go their own way regardless of your head and body position. The emergency procedures section of your aircraft technical orders gives the word when it is necessary to lower your head and body prior to jettisoning the canopy.

Remember, when instructions say merely to lower your head, you should duck your entire upper body and head down as low as possible.

A safe policy is: When in doubt—DUCK!

DUCK when jettisoning canopies from the following aircraft:

F-51 (all models)
F-80 (all models)
F-82 (all models)
F-84B and C
F-86A, D, E and F

Though not specifically noted in the Technical Order, it is wise to duck when jettisoning canopies from all F-47's, F-89's and B-45's—and in any aircraft where motion of the fuselage may slam the canopy sideways.

### Flying the Omni-Range in an AN-T-18 Link Trainer

An omni-range indoctrination device has been developed at Pepperrell Air Force Base in an effort to give local pilots a basic familiarization with the new type range instruments.

Using an AN-T-18 type Link Trainer, the ADF system was reversed, with the control dial installed on the pilot's instrument panel in the trainer. This serves as the course selector. The pilot dials his desired course and the Instrument Trainer Instructor gets the indications on his receiver dial at the desk.

To accomplish this reversal of the ADF instruments, the transmitter teletorque in the base unit was disconnected, and the instruments were switched in the desk and the trainer. Then the teletorques on these instruments were reversed, so that the teletorque in the trainer which is normally a receiver is now a transmitter. The desk teletorque is changed from a transmitter to a receiver.

The "To-From" indication was solved by installing two lights (similar to the "Z" marker light), beside the course selector in the trainer. These are connected to the 6 V transformer in the fuselage, then to a switch on the operator's desk through two blank collector rings at the trainer base.

No alteration was needed for the vertical needle doubles for this localizer-vertical needle. The ILS vertical needle doubles for this purpose.

The RMI (Radio Magnetic Indicator) has not been duplicated by this base training section as yet, so to find the magnetic bearing to the station, a pilot turns his selected course dial until the deviation needle centers, and the "To" light is on. When this occurs, his magnetic bearing to the station is indicated on the selected course dial.

**Alert shack-hanger speeds scrambles.**

As the pilot dials his selected course, and changes his position on the map—by flying the trainer, the instructor at the desk follows on the SCS-51 dial and the "To-From" switches.

Prior to setting up this system, there was no opportunity at this base for pilots to get any practical experience with VOR. The Link Section can now, in a one-hour period, give a pilot a good idea of the operation plus some actual practice with a set. Basic familiarization is accomplished by having the trainer "in the straps."

This cuts down the time necessary to check pilots out in the omni procedure. Also, in the past, pilots tended to shun the AN-T-18 type trainer in favor of the later model C-8, while now they show a marked interest in the older trainer, resulting in an increase in utilization.

The project officer, Major Walter C. Cederlund, Base Plans and Training Officer, who has worked with the Link Training Section on this development, finds that, compared to lectures and literature, he now has a much more effective system of getting VOR across to the pilots.

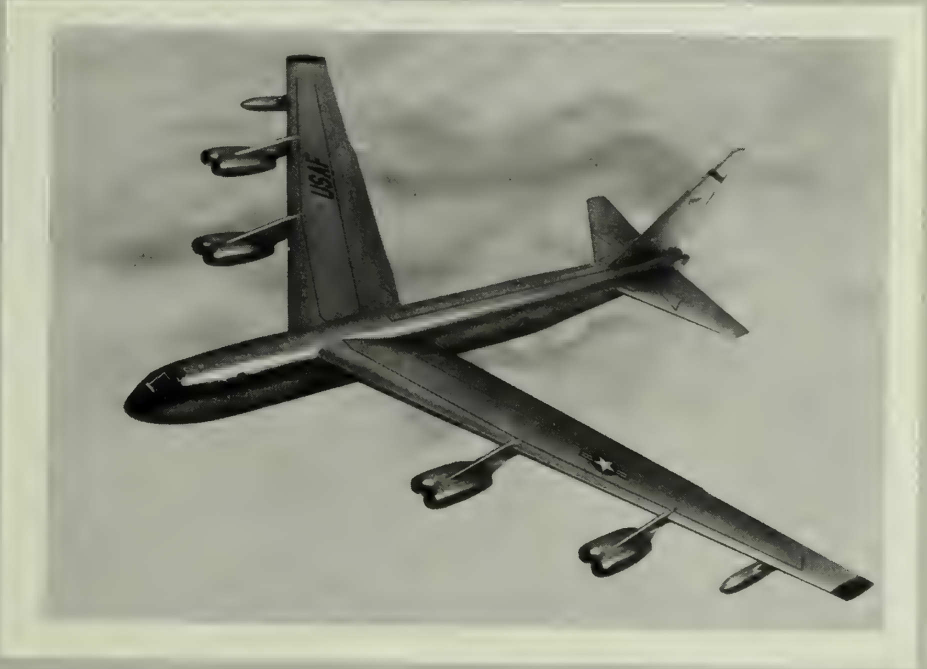
## THE NEW B-52

Pictured opposite is a model of the new B-52A Stratofortress, now in production for the United States Air Force.

The model shows the new nose and crew compartment design, with side-by-side seats for the pilot and copilot. The two prototype B-52s now flying have a tandem cockpit arrangement.

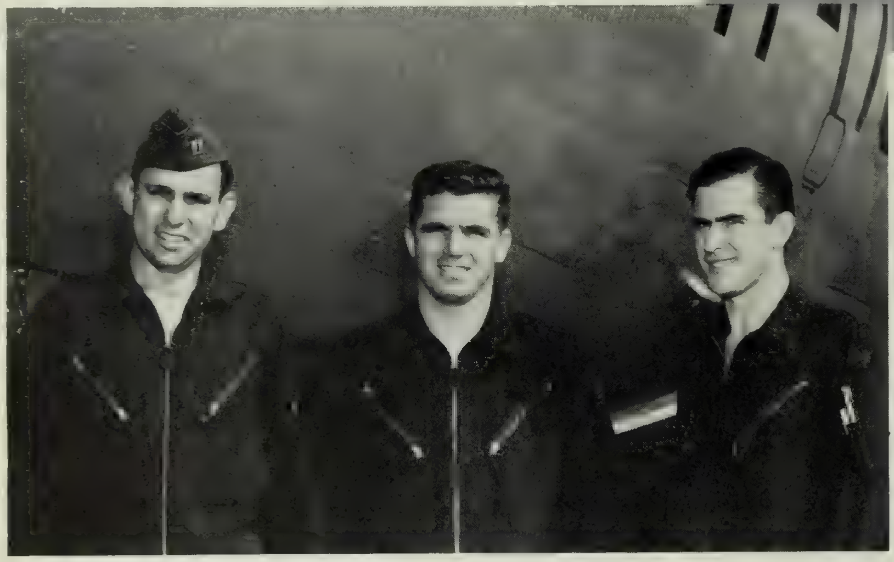
The production model will be powered by eight Pratt & Whitney J-57 turbojet engines which are mounted in four sharply raked-forward pods hung under the swept-back wing. Auxiliary fuel tanks are located under each wingtip.

The B-52s will be delivered to the USAF Strategic Air Command to form "more than seven" combat wings of heavy, long-range jet bombers, the Air Force has announced.



# T-29 FLYING CLASSROOM

**T-29B—A familiar profile . . .**


**L to R: Capt. Strain, Capt. Macruder and Mr. Snowder, test crew for the T-29D.**

*EVERY once in a while we get the feeling that the entire aviation world is completely mad — mad as a March hare about jet aircraft, that is. Straight wings, swept wings and deltas. Transonic and supersonic blowtorches replete with afterburners and supermen.*

*Well, just to be different we've decided to write about a conventional, two-engine airplane. It doesn't rumble, roar or belch obnoxious fumes. But it serves a mighty important purpose. We give you the T-29D.*

Most of you are familiar with the Convair T-29. If you haven't flown it, at least you've seen it parked on an Air Force base somewhere. The line of astrodomes marching down the top of the fuselage sets the profile of this aircraft apart from all others.

But on the new T-29D which underwent acceptance flights at San Diego, California early this winter, the familiar astrodomes are gone. Parked on the flight line at Lindberg Field the first D looked like a commercial airliner with USAF markings. Which is understandable, since the T-29D is a military version of the Convair-Liner 340. Once you've stepped inside the plane, however, the illusion that this is a commercial transport ready for a fast run to Texas is dispelled.

Instead of deep carpeting, reclining seats and a blonde hostess, the cabin is filled with training equipment. Radar and electrical equipment racks flank the aisle forward, and a curtain incloses a training area amidship. There are facilities here for six students and two instructors.

The earlier series of T-29s were also military versions of commercial aircraft (the Convair-Liner 240), designed to train bombardiers, radar operators and navigators. The new D differs from the A and B series not only in the absence of astrodomes and the rearrangement of the interior but also in the power plants and the electrical system.

The D is powered by two Pratt & Whitney R-2800-99W engines. Engine exhaust augmentors are provided for engine cooling and to supply heated air for cabin air conditioning and wing and tail anti-icing. Increased inverter facilities in the regulated alternating current supply system accommodate the electronic training equipment.

In all other systems, the T-29D is similar or identical to the B. There are two integral fuel tank areas outboard of the nacelles in each side of the wing. Total usable fuel is 1530 gallons. The two tanks on each side normally function as one tank and supply the engine on that side. A cross-feed system permits operation of either or both engines from the tanks in either side of the wing, although transfer of fuel from the tanks in one side to the tanks in the other side is prohibited.

The engine oil system was designed to Air Force requirements and is identical to that in the T-29B. A reserve oil tank with integral heating provisions, selector valve, combination pressure and scavenge pump and line scavenging timing device are installed below the floor on the right side near the aft end of the cabin. Either or both engine oil tanks can be replenished from the reserve tank in flight.

Like the T-29B, the D has three separate hydraulic systems. The main system is common to the commercial version of the aircraft and is of the semi-open center type with a normal operating pressure of 3000 psi. A manual bypass valve is opened during flight to allow fluid to circulate through the central portion of the system under low pressure. In this position pressure is trapped in the accumulator for operation of flaps and brakes. Normally, all compon-

**Flying Safety Magazine checks up on the flight characteristics and safety angles of a new addition to our ever-growing Air Force.**

. . . T-29D—Cleaner and faster.

The test crew from Edwards AFB claims the instrumentation of the cockpit is good.

ents are operated with the bypass valve in pressure position.

In the event of complete hydraulic failure, an emergency system using air pressure from a bottle releases the landing gear up latches and operates the main landing gear brakes.

The other two hydraulic systems are the alternator-generator system (which powers the hydraulic drive motors of the right generator and No. 2 alternator) and the cabin pressure hydraulic system. Pressure for both of these hydraulic systems is developed by pumps driven by the right engine.

Anti-icing, de-icing and defrosting systems are comparable to those on the commercial model. Wing and tail leading edges are anti-iced by heated air forced by ram pressure to enter heat exchanger muffs installed on the augmentor tubes. Windshields and direct-vision windows incorporate Nesa glass for electrothermal anti-icing. Prop de-icing is accomplished by A. C. powered heating elements in the leading edges of the propeller blades. A timing unit alternately routes operating current momentarily to one prop and then to the other.

Five thermocouple-type detection circuits protect the nacelle areas aft of the engine shrouds and forward of the main wheel well aft bulkheads, and the area of the reserve oil tank below the cabin floor. Fire warning lights are located above the engine instrument panel.

A one-shot extinguishing system is mounted in the left wing fillet. Controls in the cockpit enable the pilots to stop all flammable liquid flow to the fire area before discharging the fire extinguisher.

Armed with all these facts concerning the new airplane, we sought out the flight crew who were conducting the acceptance tests. They had set up temporary headquarters in a spare corner of one of Convair's office buildings, where they were busy "reducing data" gathered on the last flight. We found Captain William M. Macruder, pilot for the test flights, engrossed in a slide rule and stacks of notes. From the Flight Test Operations Laboratory at Edwards AFB, Captain Macruder is an engineering graduate of the University of California and has been in the flight test business as an engineer and a pilot for five years. He has taken part in the testing of the H-5 and H-19, and the C-124, C-125, F-86E and B-52.

Co-pilot for these tests was Captain Bailey "Skip" Strain, Flight Test Engineering Laboratory, Edwards AFB. Captain Strain has a master's degree in aeronautical engineering and prior to this assignment was with the Air Force's guided missile program.

The third member of the test crew was the flight engineer, Elden Snowder. A civilian from the Flight Test Engineering Laboratory at Edwards, he also is an aeronautical engineering graduate.

The crew were in agreement that the new trainer is a fine airplane from the pilot's point of view. "The T-29D climbs well. Short field landing and takeoff performance is good. You should be able to get into a 1500-foot strip with no trouble at all, and take off in 2000 feet at maximum weight (43,575 pounds). Single engine performance is excellent. The instrumentation of the cockpit is good. All of the controls are identifiable by feel. There's no shimmy in the nosewheel steering. The landing gear retracts fast — like a fighter. All the emergency procedures seem sound. This is definitely a two-man airplane, of course. The pilot would have a hard time reaching the landing gear handle from the left seat.

"Naturally, there are a few things we don't like. Elevator forces on takeoff and landing are pretty high.

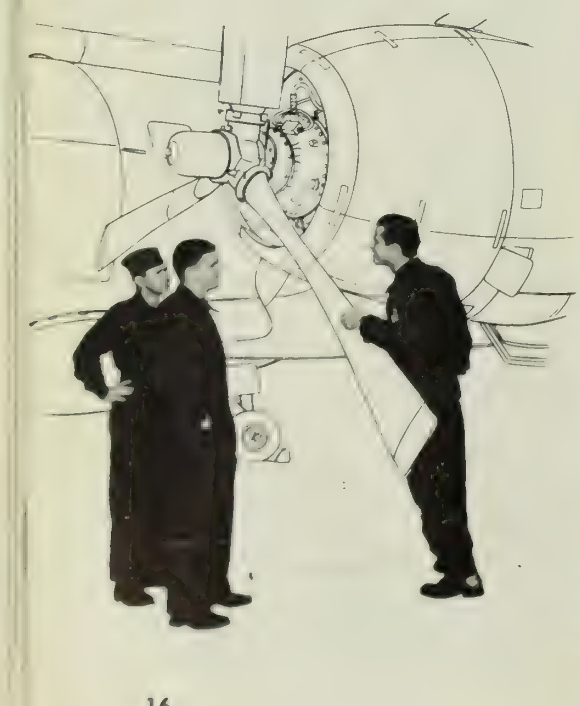
It takes a lot of trim on final approach to flare out. And in the air, aileron forces are high. The antiglare shield in the cockpit is high, and lack of visibility on climb-out and during go-around forces the pilot to resort to instruments."

We were primarily interested in what changes the test crew would recommend be made before the D's were delivered to the Air Training Command. Captain Macruder and Captain Strain pointed out that although there were a number of changes they were tentatively considering recommending, further flights would influence their final suggestions. "For instance," Captain Strain said, "there's a considerable power drain on the right engine — the aircraft's K system (electronic training equipment) and cabin pressurization are both driven by the right engine — which results in low manifold pressure and fuel pressure readings on that side. At present we think it would be a good idea to put some of that load on the left engine.

"Also, the flight instruments are on one generator, radio equipment on the other. If either generator should fail on an instrument approach, the pilots would be in trouble. We'll undoubtedly recommend changes there."

With regard to the propeller reversing system, both pilots felt it might be advisable to provide a detent on the throttles so that the props could not be put into reverse inadvertently. "At present it's possible to pull the throttles too far back and not be aware of the fact until the gear touches down." (The propeller reversing system on the T-29D does not actuate until the wheels touch.)

**The walk-around-check is emphasized by the flight test crew.**



For the sake of convenience, the crew intended to recommend relocation of the radio circuit breakers. Since they are now located in the passageway, a pilot must leave his seat to reach them. A bulkhead directly behind the pilot's position seemed a more satisfactory location.

Although they had not yet tested the automatic prop feathering device to any extent, the crewmembers were interested in discussing the item, which is a carry-over from the commercial version of the airplane. The automatic feathering system is intended to prevent manual feathering of the wrong propeller during emergencies. The system is operative any time the autofeather master switch on the pilot's pedestal is in the ON position. The switch is located in front of the pitch control levers and is covered by a red guard which must be raised to place the switch ON. Illumination of a green light near the switch gives indication that the switch is ON and the system is prepared to operate.

The system will operate whenever the BMEP drops to 70 or less and the throttle remains in the open position above 75 per cent power application. Throttle switches are controlled by cams attached to the throttle lever torque tubes. The cams are adjusted to actuate the switches at a throttle position corresponding to 45 inches manifold pressure at sea level. Each throttle switch, when supplied with power from the corresponding torque pressure switch, controls the power supply to the control coil of the corresponding feathering switch through a time delay unit. Autofeathering, therefore, can take place only when the throttle switches are closed (throttles advanced beyond the 45 inch manifold pressure position). The throttle switches are used to prevent a propeller from feathering when power is reduced by retarding the throttles.

The autofeathering control switch is turned OFF when the normal climb has been established after takeoff. The feathering switch must be reset each time the autofeathering system has been operated in order to allow the blocking relay to return to the normal position. The blocking relay prevents automatic feathering of the opposite prop when one propeller has been feathered automatically or manually (provided such manual feathering occurs while the autofeather circuit is armed).

A two-second time delay feature is incorporated in the feathering circuit to eliminate the possibility of the propeller feathering during temporary lags in engine power. The two-second delay is comprised of two equal time delay periods: (1) an inherent one-second delay in the torque oil pressure system, and (2) a one-second delay in the electrical circuit brought about by action of two thermal relays in parallel, each set for one second.

Two test switches, one for each propeller circuit, are used to insure proper operation of the automatic feathering system before takeoff. Manual feathering is accomplished in the conventional fashion.

The question in the minds of the flight test crew was whether this safety device was of sufficient value to warrant the additional maintenance time required to keep the system inspected and operative, and the risk of the device's failing in flight.

By the time acceptance tests are completed, the crew may have decided to recommend changes other than those mentioned here. Additional flights and study may also have convinced them that some of the changes they had contemplated recommending were not advisable after all.

If you are one of the pilots who will fly the first T-29Ds which were delivered to the Air Training Command early this year, or if you are a bombardier, radar operator or navigator training in the aircraft, you may find the big new trainer just as we've described it. Or you may find some changes have been made.

In any event you will be sure that the many experts in aeronautical engineering and electronics who have been associated with the development of the T-29D and the pilots who conducted these acceptance flights have made sure the airplane will accomplish your mission in the safest and most efficient manner possible. Albeit without those plush airline accommodations you expected the first time you saw the airplane. ●

# Hot Potato— MATS STYLE

## MATS Comes Up With a New Spark for Old Flying Safety Meetings.

LOOKING for new ideas to spark your Flying Safety program? All too often we hear the old cry, "What can I use for material in my Flying Safety meetings?"

Sometimes that does pose a very real problem, especially for the officer who is new to the game. This business of deriving maximum benefits from each scheduled meeting isn't easy, by a long shot. Ask any old hand — But it can be done!

MATS has come up with a new and very realistic approach to this problem. It's so good in fact we are passing it along to you. MATS calls this the "Pilot Judgment Quick Decision Exercise," and we feel it may be best explained by direct quotes from a recent copy of their pamphlet.

This pamphlet has been prepared for the discussion method of instrucion which moves more slowly than does the lecture type. The discussion method has certain advantages.

First, it is personalized instruction.

Second, the group members are participants and do not merely listen. They must be on the alert for the moment the leader will call upon them. It is through the cooperation of the group members that an acceptable judgment (conclusion) is reached. During flight, teamwork is essential, and when the same people are led to a "meeting of the minds" by discussion, it is certain that better flying teams will result.

The group leader for this discussion should be the Squadron Commanding Officer, the Operations Officer or the Flight Safety Officer.

When the Commanding Officer conducts the meeting or actively participates in the meeting, he will have an excellent opportunity to analyze his pilots by their decisions. His presence will emphasize the importance attached to the program.

It will be the discussion leader's responsibility to confine the discourse to related facts and judgments. The success of this form of idea interchange will depend upon the leader, and, as compensation, his leadership will be improved.

Since the first fatal accident of Lt. Selfridge, 17 September 1908, while piloting his Wright Flying Machine, human error has been accounting for more than half of the Air Force accidents. Under the causes for human error, the largest and most costly single factor for the many accidents is the pilot's inability to make proper judgments (decisions). In our time of increased aircraft size and complexity, when *one* pilot is sometimes responsible for the safety of more than 100 lives, it becomes apparent that the transport pilot's judgment must be superior.

The information contained in the following exercise was extracted from the report of a C-54 accident which took place at a western Air Force Base; however, it could pertain to any type aircraft. The accident involves some of those judgment deficiencies which are common during Ground Controlled Approaches.

**"The aircraft struck the telephone pole 2700 feet before reaching . . . the runway."**

Study this exercise before presenting it in a meeting. Use only those questions and answers which will be of value in standardizing your particular operations. The use of the blackboard for a clearer presentation cannot be over-emphasized. Discuss the approximate position of the runway and range station, holding pattern, etc.

### History of Flight

The instructor pilot and crew of ten, including three student pilots, departed from their home base at 1430 hours in a C-54. The purpose of the flight was training and the flight cleared to a nearby base where two hours of transition were completed.

While filing a return clearance, the pilots were briefed on the weather, which was measured 3500 overcast, 2000 feet scattered, visibility two miles with snow showers. The temperature was 33°, the dewpoint 28°, wind calm, and the altimeter 30.02. The forecast for the time of arrival at home base was: ceiling 2000 lowering to 600 feet. Visibility five miles, lowering to one mile in snow showers. GCA minimums for home base at night were 600 feet and one mile. The base which was listed as the alternate was forecasting 2000 feet and seven miles visibility.

The flight departed at 2020 hours and proceeded to the radio range station. The IP elected to remain in the right seat because, as he stated, he had learned from past experience that pilots just returning to duty after a break in flying were not proficient in radio procedures.

While waiting for a GCA frequency, in a holding pattern at 4000 feet, the local weather was requested and given as: ceiling 300 feet, visibility one mile with snow showers.

1. Question: What would your decision be?

Answer: Request to hold until the weather improves, or if the weather forecast was going to remain below minimums, request a clearance back to the point of departure.

2. Question: According to MM 55-1, which seat should the IP be in at this time?

Answer: Left. MATS Manuel 55-1, Par. 51.13 states: "On difficult takeoffs and landings and during adverse flight conditions, he (the Aircraft Commander) will occupy the left seat and be in control of the aircraft."

The IP elected to attempt a ground controlled approach and radio contact was established with GCA. While he was receiving instructions relative to his run, which was to be made on runway 34, radio reception became intermittent and then stopped completely. The flight was descending in a GCA pattern at this time.

3. Question: What procedure should be followed now?

Answer: Return to the range station, contact approach control and request further clearance.

Climbing to 4000 feet, the IP returned to the range station, where contact with GCA was established again.

Another approach was attempted, with the same results. During the third approach, communications were lost while GCA was trying to turn the aircraft onto the final. When communications were again established, the aircraft had overshot the turn onto final to such an extent that a new pattern was necessary. The IP switched to tower frequency, and while returning to the range, requested an ARTC clearance to return to their point of departure. Over the home range station, waiting for this clearance, he was advised that GCA had changed transmitters and to contact them again if he desired another approach.

4. Question: Would this have influenced you?

Answer: No. The IP should have followed through with his request and returned to the point of departure.

The IP elected to try another approach. During this approach, radio contact seemed to be good, so he decided to continue with the run. On the final, just before the IP heard GCA say, "You are going through GCA minimums," the engineer told the pilots he saw lights ahead. The IP saw a few lights through blowing snow and assuming that they could be runway lights, permitted the approach to be continued.

5. Question: What mistake was made on the final approach?

Answer: The pilot went below GCA minimums.

6. Question: What should he have done?

Answer: If positive runway identification cannot be made at GCA minimums, effect a pull-up following GCA emergency pull-up instructions.

Any pilot continuing an approach without positive runway identification is inviting trouble. Such reasoning has caused aircraft to be landed on

**The participants must be alert to the discussion for they may be called upon at any minute to answer a direct question.**

●

**Blackboards greatly aid this type of presentation. Right and below, everyone gets into the act as group leader and a member of the audience make a point.**

ramps where maintenance lighting was bright, and in another instance, when only boundary lighting was sighted, the final maneuver to align the aircraft was so violent that it cost the aircraft a wingtip.

An Air Force runway has green lights marking the beginning, and the runway boundary lights are uniformly spaced, not to exceed 200 feet, located directly across from each other. If the runway cannot readily be identified at GCA minimums, you are not visual.

The last altitude the IP remembered seeing on the altimeter was 700 feet. The pilot at the controls remembered seeing 600 feet. When positive runway identification could not be made, and a dark object loomed up ahead, the IP started to apply maximum power. The aircraft then struck an unknown object. Immediately the manifold pressure on No. 4 engine went to approximately 60 inches, throttle control was lost, and the cylinder head temperature started to drop.

7. Question: What would you do now?

Answer: When at minimum safe altitude, and control of the aircraft had been established, feather No. 4 propeller.

The IP feathered No. 4 propeller and continued his climb to 9000 feet. During the climb the aircraft began to buffet severely. Ten degrees of flaps were lowered and the climb was continued. At 9000 feet he leveled off, maintained 140 IAS, proceeded to point of departure, and landed.

8. Question: What could be attempted to reduce the buffeting?

Answer: Slow the aircraft. Lower flaps, if necessary. When the flaps are lowered it establishes a higher position for the empennage and the flaps effect a downwash of the airstream.

If the turbulent air is originating within the area of the wing, the flaps assist in removing the empennage from the flow of turbulent air.

Investigation after landing revealed that a two-foot section of telephone pole was imbedded in the leading edge of the wing between No. 3 and No. 4 engines. There was no damage evident to No. 3 and No. 4 propellers, even though it seemed necessary for the pole to have passed between the two props.

NOTE: The aircraft struck the telephone pole 2700 feet before reaching the landing end of the runway, 117 feet to the right of the center line, and 56 feet above the elevation of the runway.

### Conclusion

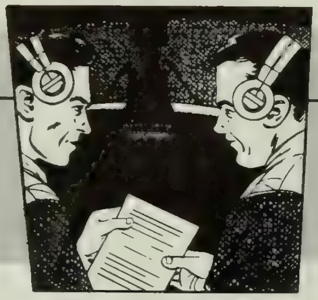
It was concluded that the instructor pilot, knowing the weather conditions and the minimum letdown limitations at his home station, descended below these minimums where the aircraft struck a telephone pole causing major damage.

It was also concluded that the IP did not exercise proper judgment in allowing the student to make GCA runs under the existing weather conditions.

Here we have but one example of how the "Pilot Judgment Quick Decision Exercise" works. We feel sure, however, that after reading this article, you will envision immediately applying these principles of group discussion and it doesn't matter whether your organization flies C-124's or L-5's, the same realistic approach will pay rich dividends.

We feel that the factor of paramount importance centers around the very real "personal touch" of all discussion participants. Every pilot in the group will have the feeling that he will be called on next to answer a question. He's got to have his response prepared long before the question is asked and consequently will be on his toes throughout the entire exercise ready to answer.

Why don't you try this same approach at the next flying safety meeting? Bet you'll be surprised at the response. ●



# CROSS FEED

## LETTERS TO THE EDITOR

### More On "Scotchlite"

This office is extremely interested in your article, "Detection Through Reflection," published in the October issue of FLYING SAFETY. It would be greatly appreciated if you could furnish three or four copies for distribution to the Airline Transport Association and to the Air Line Pilots Association.

**E. W. Burton, Actg Chief**
**Special Ops Br, CAA.**

*Flying Safety's happy to oblige!*

★ ★ ★

### Our Slip Is Showing

I would like to express my appreciation for the work your organization is doing. I read and digest every article in the FLYING SAFETY Magazine and over a period of years have learned many interesting items about aircraft accident prevention. It is, therefore, with a good deal of humble respect that I submit the following criticism:

In the August 1953 edition, in your article, "That UNLUCKY Old Sun," on page 22 you state: "At high temperatures these cables may become slack." This statement is contrary to all laws of physics. The Air Force has published a number of rigging charts on the subject that should be recalled — the graphs run 180° opposite what they are now, i.e., the hotter the temperature, the higher the cable tension. In addition, take into consideration the expansion characteristic of steel and aluminum, also the area of each airplane or cable exposed to the higher temperature.

**George J. Doerner**
**AF Inspector**
**Edwards, Calif.**

In your August issue of FLYING SAFETY, in your article, "That UNLUCKY Old Sun," you state that control cables may become dangerously slack due to high temperatures.

I think you will find that this is an erroneous opinion shared by many people. In some of our early type aircraft of steel frame construction, this condition was possible, but with modern aircraft constructed of aluminum, the converse of this is normally true.

If you will check the coefficients of linear expansion of aluminum and steel you will find that aluminum in the framework of a plane will expand or elongate nearly two and one-half times as much as the steel control cables. Therefore, when the temperature increases, the control cables will actually tighten.

**Major Francis H. Morris**
**21st Maint. Sqdn**
**George AFB, Calif.**

This letter is about the article, "That UNLUCKY Old Sun," printed in the August issue of FLYING SAFETY. On page 22, under the subheading "Check Control Cables" it says in part: "at HIGH temperatures these cables may become slack and your controls may become loose to the danger point."

No statement could be more erroneous. The expansion of aluminum dural is almost three times that of steel.

I would like to call your attention to TO 01-1A-8, Sec. IX, Par. 9-17. This paragraph is about temperature compensations. I believe that after your referral you will or should print a retraction of this statement.

**Woodrow F. Hurst**
**A/C Wgt & Bal Insp**
**SMAMA, McClellan AFB, Calif.**

*All three writers are correct. Our faces are red.*

★ ★ ★

### To All in The Fifth

I noticed in the September 1953 issue of FLYING SAFETY Magazine that you had a picture page praising the Pilots and Crews of the Fifth Air Force for their contribution to the Korean conflict.

In the article, you gave credit to all outfits, or type of aircraft, except ours, the 6167th Air Base Group. We used C-47 and C-46 type aircraft and were not a part of Troop Carrier. I am proud of my old outfit and I think they deserve a pat on the back, too, for a job well done.

I thank you in advance for any consideration you may give this letter, and I would like to give FLYING SAFETY a hearty handshake for the swell job they are doing in keeping air crewmembers up to date on current events in flying.

**A/2c Charles M. Clark**
**776th TC Sq (M)**
**Lawson AFB, Georgia**

*Space limitations prohibited our mentioning each unit attached to or type of aircraft used by the Fifth Air Force in Korea, but our "Well Done" was intended for ALL outfits of the Fifth.*

★ ★ ★

### A Word of Warning

Here's an item that should be brought to the attention of all C-47 pilots and the idea should certainly be flight checked in other twin-engine type aircraft.

The C-47 cannot maintain altitude and airspeed with a runaway propeller which cannot be feathered. To check this for accuracy, I suggest that C-47 pilots simulate this condition by throttling one engine all the way back, placing that propeller in low pitch (high rpm), and then try to stay in the air. Skeptics, beware!

An incident of this nature happened at this overseas station when a pilot held the button in too long on an unfeathering procedure and the propeller stuck in low pitch (high rpm). The aircraft was landed wheels down in a favorable cow pasture. If the propeller had run away at night you can assume that the results would have increased our accident rate.

To preclude this situation we have published a directive that practice feathering will be conducted at a minimum altitude of 5000 feet and within gliding distance of a USAF base.

**Lt Col Thomas M. Glassburner**
**Prs., 5th Air Div Stand Bd**
**APO 118, c/o PM, NY.**

### *FLIGHT ASPECTS OF THE*

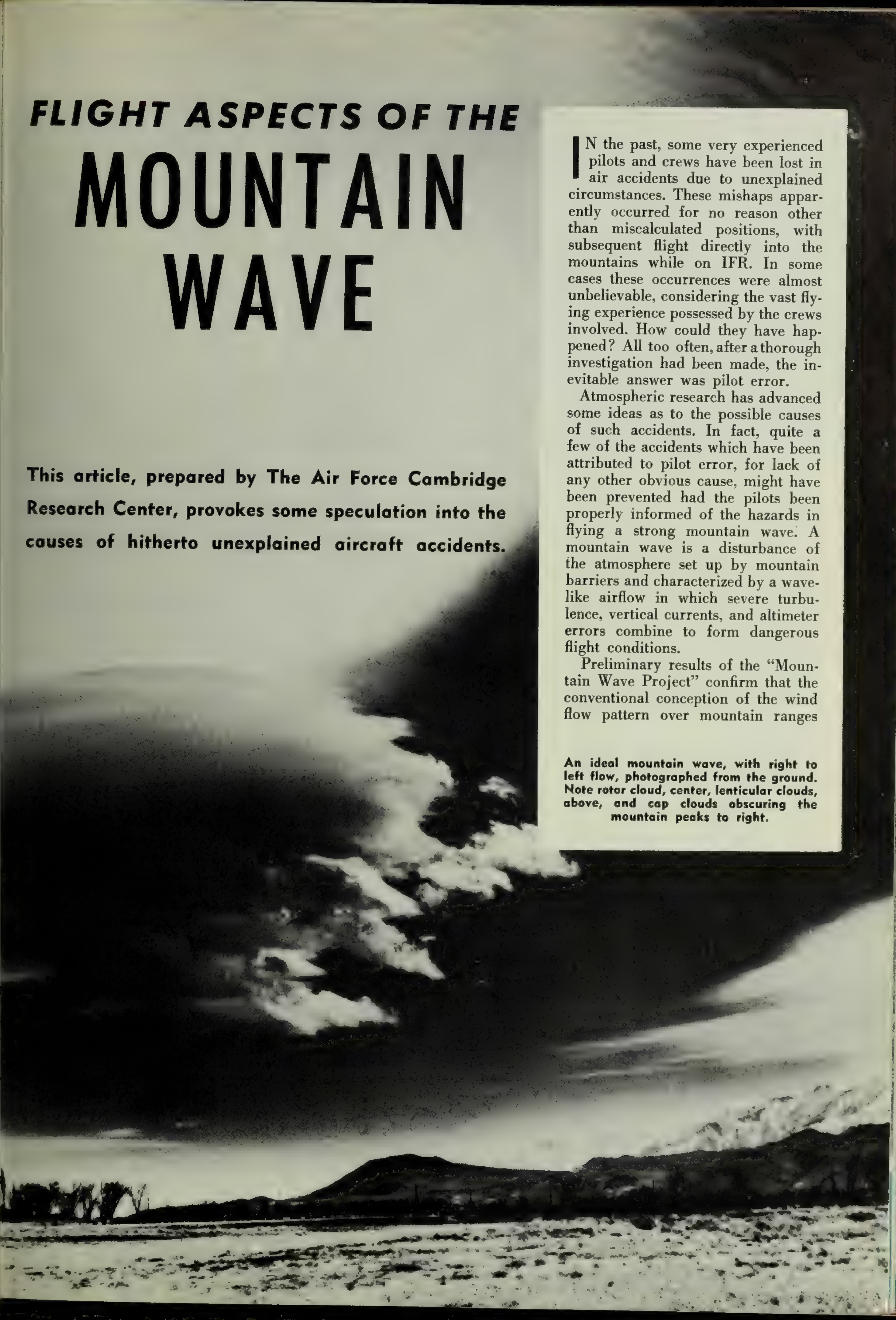
# MOUNTAIN WAVE

**This article, prepared by The Air Force Cambridge Research Center, provokes some speculation into the causes of hitherto unexplained aircraft accidents.**

IN the past, some very experienced pilots and crews have been lost in air accidents due to unexplained circumstances. These mishaps apparently occurred for no reason other than miscalculated positions, with subsequent flight directly into the mountains while on IFR. In some cases these occurrences were almost unbelievable, considering the vast flying experience possessed by the crews involved. How could they have happened? All too often, after a thorough investigation had been made, the inevitable answer was pilot error.

Atmospheric research has advanced some ideas as to the possible causes of such accidents. In fact, quite a few of the accidents which have been attributed to pilot error, for lack of any other obvious cause, might have been prevented had the pilots been properly informed of the hazards in flying a strong mountain wave. A mountain wave is a disturbance of the atmosphere set up by mountain barriers and characterized by a wave-like airflow in which severe turbulence, vertical currents, and altimeter errors combine to form dangerous flight conditions.

Preliminary results of the "Mountain Wave Project" confirm that the conventional conception of the wind flow pattern over mountain ranges



**An ideal mountain wave, with right to left flow, photographed from the ground. Note rotor cloud, center, lenticular clouds, above, and cap clouds obscuring the mountain peaks to right.**

is in error. This is particularly true when a strong flow exists perpendicular to the ridge lines, as required for the formation of a mountain wave.

It is intended that this survey provide pilots with a more complete picture of the wave and with a detailed description of its structure. Additional meteorological information on the subject is contained in Air Force Survey in Geophysics No. 15, "Forecasting the Mountain Wave," Sept. 1952.

Let us first accompany a pilot as he attempts to traverse a strong mountain wave without sufficient knowledge of its characteristics. A great deal of flight experience in the study of such waves has been incorporated here in an attempt to give pilot readers a feeling of what they might encounter were they unaware of the experiences to be expected. Later in this report the wave phenomenon will be explained as to its formation and features.

### Mountain Wave Encounter

Let us suppose you are fighting strong head winds at 10,000 feet altitude in a moderate-speed aircraft. Two hundred miles ahead on your flight course is X-Mountain. It may be one of the Rocky Mountain ranges when you are heading west; it may be the Alps when you are heading south or it may be just a small, little-known ridge.

There are not many clouds around and visibility is very good. The air is smooth up here although in the lower layers it is quite turbulent. You are flying with a slight drift correction. Some time ago you spotted a long white cirrus band over the horizon far ahead. At about 100 miles from X-Mountain you notice that this cloud bank seems to extend just along the mountain range although at a much higher level than the peaks of the range. Apparently it does not move, despite strong upper winds. The summits of X-Mountain cannot be seen. They are covered by a flat, white cloud blanket.

Every minute you can see more details. The high cirrus cloud ahead consists of a few parallel banks extending from right to left, normal to the wind. As you approach this cloud it does not look as white and harmless as it looked from 200 miles away. There are dark, dense parts in it and you would not dare to guess how high it is. You would not even call it a cirrus cloud any more. It looks more like a big altocumulus cloud. You can see that this cloud is composed of a number of layers staggered vertically like pancakes. The leading (upward) edge appears quite sharp and seems to follow every band in the long mountain range.

Farther upwind blue sky extends over the flat cloud blanket (cap cloud) which covers the mountain tops. The high cloud extends only downwind of the mountain range. It is a so-called lee cloud.

You are now 50 miles from X-Mountain. Climbing slowly you should be able to pass below the high altocumulus cloud and then above the cap cloud and X-Mountain. There is a wide gap of blue sky between these two cloud layers, and except for some long lines of cumulus clouds under the high cloud bank, you do not expect any clouds at all on your flight path and head directly into this gap.

Field location of the project in the Sierra Nevada Mountains.

Apparently there are two of these cumulus lines extending from right to left just this side of the mountain range. They look so harmless that you really do not worry about penetrating them. The row nearer you consists only of some broken, ragged cloud pieces (fracto-cumulus). They seem to be just about as high as the mountain tops and the cap cloud. The cloud line nearer the mountain range looks much more dense and builds up higher than the cap cloud over the mountains, although it is certainly not comparable in depth to the big shower clouds you have had to penetrate sometimes. None of the cumulus clouds here give any indication of precipitation.

As you cannot estimate how much space exists between X-Mountain and the cumulus lines you have to decide now if you want to pass beneath, above or through the cumulus clouds. Had you heard about the "Mountain Wave" earlier, you would have made up your mind a long time ago. You would know by now that the harmless cloud picture ahead displays all indications of impending danger. Now you have to learn it the hard way!

You decide to continue your flight towards the cloud gap by climbing steadily. You will probably pass through the first tiny cumulus line which is now only a few miles ahead. Fixing your eyes on some of the cloud fragments you notice that they show strong rolling motion. You remember having heard of a roll cloud and anticipate some turbulence.

Upon contact with the first cloud pieces, your ship banks steeply and you are thrown against the ceiling of your cockpit. You have your hands full to regain control of the plane and you do not find any time to watch your altimeter or rate of climb indicator. Nevertheless, you feel that the plane is climbing and descending rapidly in what you would call severe turbulence.

This dance lasts only one or two minutes; then suddenly the air is smooth again and you have a good rate of climb. You have passed the first roll cloud and have time now to fasten your shoulder straps and to think your situation over. Looking upwards you notice that the high cloud is now huge and compact, completely shading the countryside. Your decision to climb over the cumulus lines seems justified by your first experience.

The rate of climb is unusually good after passing the first roll cloud. You can already see over the next cloudline, which seems to be five to ten miles ahead, and you should have plenty of height to clear even the highest cloud tops of this roll cloud. With the air quite smooth you are confident that you are out of trouble by now. Looking down at the valley floor you notice that jet-like dust streaks indicate strong surface winds. Your progress is slow. Apparently the upper winds are very strong. As a consequence you have to change your drift correction to stay on course.

Now you are high enough to look down on the next roll cloud. The cap cloud over X-Mountain ahead is snow-white in the brilliant sun. It seems to pour down the mountain slope like a cloud waterfall. Farther upwind the cap cloud merges with the horizon and it is hard to estimate whether you are higher than this cloud layer or not.

The huge altocumulus cloud above is even darker now. The leading (upwind) edges of the different pancake layers are staggered toward the wind. The highest one is still far ahead and shows a brilliant white rim. Now you can see the profiles of the staggered layers. They are lens-shaped and you remember having heard meteorologists say that lenticular clouds occur frequently over mountains.

Something unexpected must have happened suddenly. The roll cloud ahead has started to build up quickly in front of you. Looking downward you notice that the plane does not seem to be making any headway. Now the first cloud drifts by under the plane. If the cumuli continue to rise that way, you are not sure that you can make it.

A glance at the rate of climb indicator reveals what is going on: the plane is descending at over 2000 fpm in completely smooth air. What you need now is groundspeed. With the nose down and full power, clouds seem to shoot by underneath the plane but the ground still does not show noticeable movement. The rate of descent is now 2500 fpm. A big cumulus turret builds up ahead and engulfs the plane within seconds. You have fallen from above into the roll cloud.

What follows is no longer controlled instrument flight. Heavy gusts make all the instruments dance. The speed drops down, then shoots up, the rpms are changing rapidly and the engine is howling. Several times you hang in your belt without the slightest idea of attitude. You have not encountered anything like this before. You recall a thunderstorm flight which scared you to death but the turbulence was nowhere near this bad.

**A project sailplane soaring over a mountain wave cloud formation.**

Suddenly you drop out of the cloud base and the view startles you: everything seems to have changed. X-Mountain looks down on you like a big barrier, the clouds sweeping down its slopes in front of you. You are about ready to turn back when your plane is lifted with enormous power. In heavy vertical gusts your rate of climb jumps to 1000 fpm, later to 2000 fpm.

The leading edge of the cumulus line is now just above you. To avoid being pulled back into the roll cloud you push the nose down. Apparently you now have a good groundspeed and the plane is climbing fast in front of the cloud line which looks like a long railroad train. Suddenly the gusts die out. The air becomes smooth as glass. But your rate of climb is now 2500 fpm. You are stunned by the fact that such extreme degrees of smoothness and turbulence can coexist so closely in the atmosphere.

Looking back after a few minutes you notice that you are already higher than the top of the cumulus line. That should be enough, finally, to cross X-Mountain and the cap cloud. You are now flying at a safe level. Your altitude is 3000 over X-Mountain and probably 2000 feet over the cap cloud. There is no roll cloud line ahead now and you have reason to believe that you are out of trouble.

The foot of X-Mountain lies just below you. The trailing edge of the cap cloud is only one mile ahead. The cloud mass pouring down the mountain slope and dissipating is a fascinating spectacle. The upwind edge of the high lenticular cloud is directly overhead, maybe between 30,000 and 40,000 feet.

The plane makes good headway now but the updraft is slowly tapering off and you have to use more power to keep altitude and groundspeed.

High as you are above the low-level clouds you feel almost—but not quite—safe. This completely smooth air has proved treacherous before and you are not sure what it has in store for you this time. The crestline of the mountain is not yet passed and groundspeed seems to drop again. After another minute the low clouds look nearer. There has been no indication of what your altimeter and rate of climb now reveal: You are descending again at 1000 fpm, and full throttle does not help. You feel if you can go another mile upwind you should be through.

But once more there is this unfortunate combination of a jetlike headwind and a strong downdraft. You have been running through several consecutive up and downdraft areas.

This is indeed the pattern of an atmospheric wave. In another minute you will know if you can pass X-

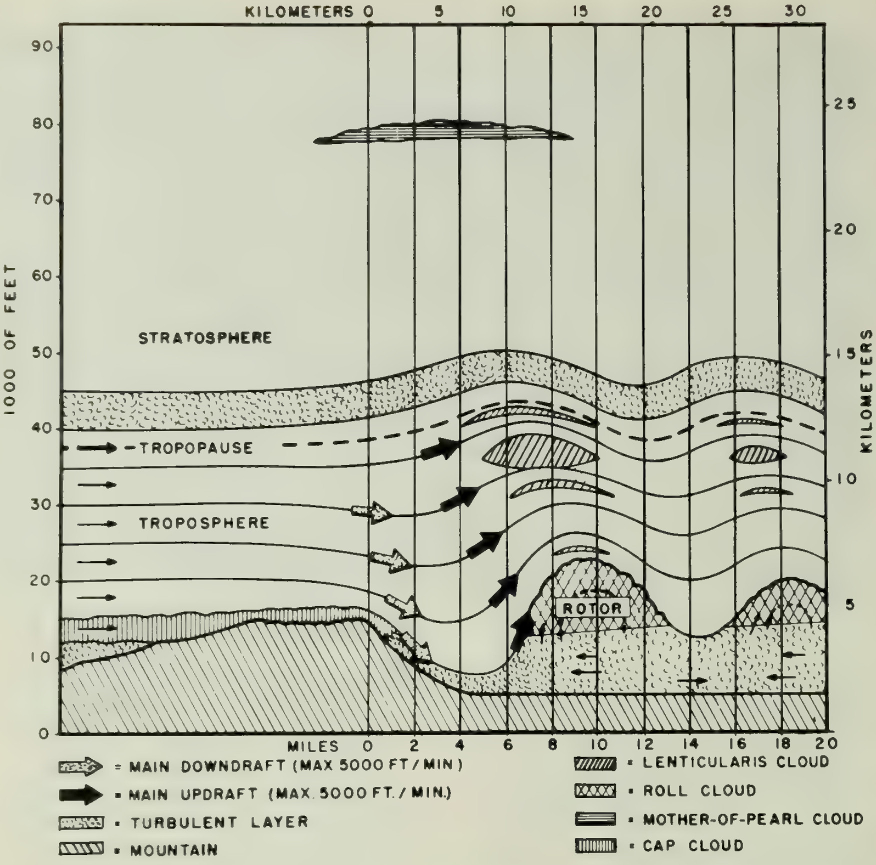


**Fig. 1. A cross section depicting the conditions generally associated with a typical mountain wave, frequently referred to as the foehn phenomenon.**

Mountain. The cloud waterfall is directly beneath the plane now. But in front of you the cap cloud climbs fast. The air is still quite smooth, but now you are descending at about 3000 fpm. Three thousand feet per minute? That means you will crash into the mountain within another minute. What does your altimeter show? A thousand feet above the highest peak of X-Mountain. But now you can see a mountain peak through the cap cloud. That is certainly not 1000 feet below you. It is just about your present height. Is the altimeter wrong? Only a quick decision will save you. Turn back.

While you bank in a steep left turn the air becomes hazy. A glance at the instrument panel and the mountains shows that you are descending at almost 4000 fpm into the lower end of the cloud waterfall. Suddenly a terrific gust banks the airplane into a steep right turn towards the mountain. For a moment you see the rocks of the mountain rapidly coming nearer. Then you succeed in maneuvering the plane away from the stone wall.

You are right in the foot of the cloud waterfall which looked so smooth from above and the airplane shoots with a tremendous tailwind 1500 feet out over the valley floor. As the heavy gusts diminish you look back on the towering mountain range and the cap cloud which only a few minutes ago lay below the aircraft.

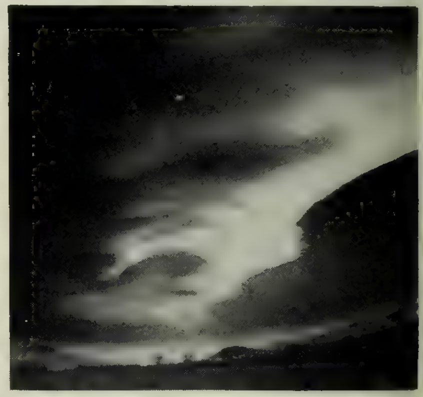
In a matter of minutes you have passed under the two roll clouds and the nightmare is over. You decide to do what you should have done in the first place: change your flight course, fly around X-Mountain and avoid traversing a full-scale "Mountain Wave."

The foregoing probably describes a typical mountain wave experience. In this case, the pilot encountered a very powerful wave, but with the favorable factor of good visibility which enabled him to recognize cloud types and thus orient himself and maneuver the ship out of immediate danger. It is conceivable that the situation would have been more serious if the wave were very dry, with no clouds to give any indication of hidden danger; or on the other hand, if the mountain wave were completely obscured by a massive cloud layer.

## Mountain Wave Project

To investigate this type of airflow,

**A typical cap cloud or a "foehn wall" is sweeping down a mountain slope.**



**The smooth cloud texture and well defined edges indicate a laminar motion.**

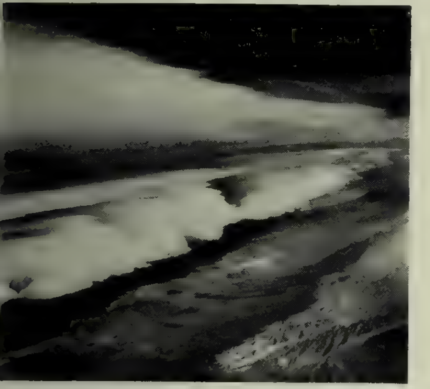
the "Mountain Wave Project" was implemented under the joint sponsorship of the Geophysics Research Directorate of the AF Cambridge Research Center and the Office of Naval Research. It was conducted by the University of California in cooperation with the Southern California Soaring Association and several government and private organizations.* The field tests were carried out during 1951-1952 in the Sierra Nevada mountain range in California under the direction of the Geophysics Research Directorate.

Specially instrumented sailplanes were used to trace the streamlines and the temperature and pressure field in the neighborhood of the mountain range when a strong flow existed perpendicular, or nearly perpendicular, to the ridge lines. Conditions were investigated up to a record height of 44,500 feet by use of these sailplanes which were

---

*These included the U. S. Weather Bureau, the Air Weather Service, the Naval Ordnance Test Station at Inyokern, the Hastings Instrument Co., the Symons Flying Service, the Institute of Numerical Analysis, the Air Force Shadow Mountain Lab and others.

**A typical stationary roll cloud formed downwind of partially obscured peaks.**



**The tops of the rotor cloud are starting to merge with the lowest lenticular clouds.**

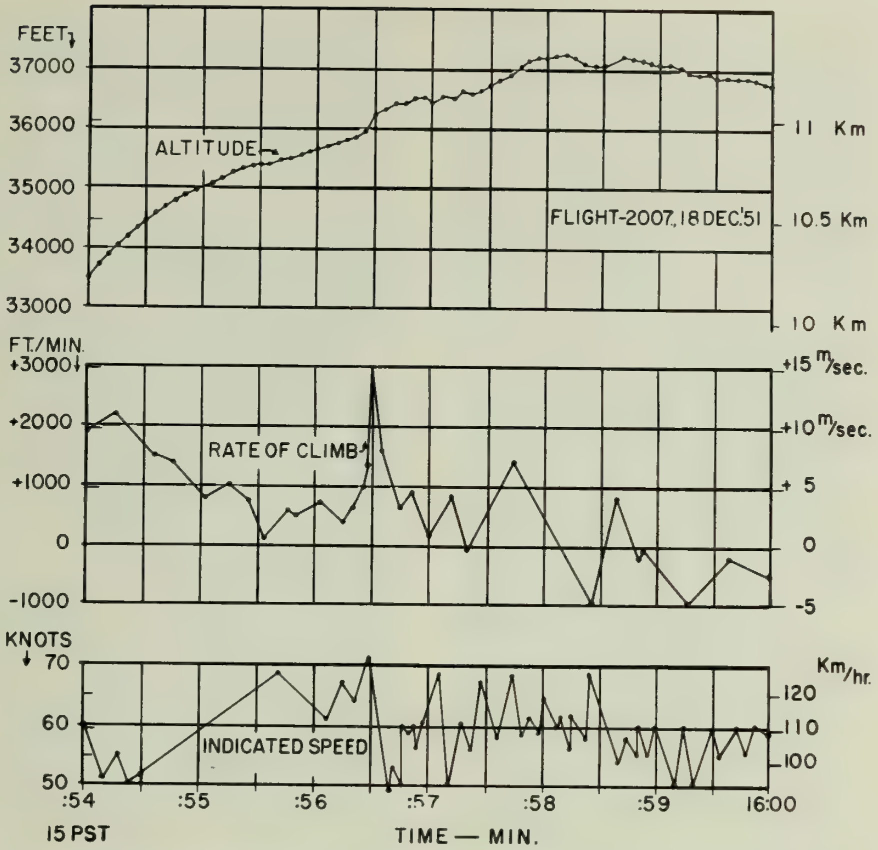


**Fig. 2. High level turbulence encountered between 36,000 and 37,000 feet by one of the project gliders in the same wave which is depicted on page 26.**

tracked by radar, Raydist and cine-theodolites. Time-lapse cameras took motion pictures of the associated cloud structures from the ground to supplement the data taken by the sailplanes. Meteorological stations were established on both sides of the mountain range from the valley floor up to an elevation of 9000 feet.

Gliders were preferred to powered planes or balloons in this project because of their small sinking rate, low speed, maneuverability, and accuracy of calibration. They can remain aloft for many hours traversing the wave using updraft areas to gain altitude and, due to their low speeds, can be used to investigate the structure of severe turbulence which higher-speed, conventional aircraft try to avoid.

### Airflow and Clouds

Figure 1 is a cross-section depicting the conditions generally associated with a typical mountain wave, which meteorologists often refer to as the foehn phenomenon.

The picture on page 21 is an actual photograph of such a wave. As indicated in Figure 1, the mountain range at the left extends to about 14,000 ft. MSL and the wind flow is from left to right. In the flight described earlier in this report, our pilot was flying from right to left and the diagram illustrates the wave-like motion of the flow and the different cloud types he encountered.

The cap cloud in the lower left corner of Figure 1 hugs the tops of the mountains and flows down the leeward side with the appearance of a waterfall. Since it hides the mountains and is connected with the strong downdraft area on the leeside of the peaks, the cap cloud is dangerous.

Looking from the valley floor toward the mountain this cloud mass sometimes gives the appearance of a cloud wall, which is responsible for the name "foehnwall," frequently used for this cloud type.

The downdrafts can be as strong as 500 fpm. As our pilot discovered, one must have more than the minimum required clearance to traverse such powerful down currents.

Some distance downwind of the cap cloud (lower center of Figure 1) the air shoots up again almost vertically, forming the rotor or roll cloud. At times its base is below the mountain peaks and its top reaches considerably above the peaks, sometimes to twice the height of the highest peaks and occasionally to over 30,000 feet.

The rotor cloud may well extend to a height where it merges with the lenticular clouds to be described in the next paragraph. While often appearing harmless, the rotor cloud is dangerously turbulent with updrafts of up to 5000 fpm on its leading edge, and equivalent downdrafts on its leeward edge. There is a constant boiling motion in and below this cloud.

In overall shape and location, it is effectively a stationary cloud constantly forming on the windward side and dissipating to the lee. There are instances where the roll clouds build up to such a height that precipitation and even thunderstorms form.

Frequently a number of consecutive roll cloud lines extend parallel to the mountain range, each marking a wave crest. The initial roll cloud may be present anywhere from a position immediately to the lee of the mountain peaks to a distance 10 miles downwind. In the latter case one might naturally assume that the lift zone ahead of the rotor would be very broad and gradually taper off.

This is not true, however; the updraft area can be just as sharply defined as the roll clouds closer to the mountain.

The lenticular or lens-shaped clouds (Figure 1) which appear in layers sometimes extending to well above 30,000 feet are relatively smooth. The tiered appearance of these clouds is consistent with the smooth laminar flow in this section of the wave and is due to the stratified character of the humidity in the atmosphere and to the lifting effect of the wave on the whole depth of the atmosphere, which creates condensation in the humid layers.

These lenticular clouds, like the rotor, are stationary, constantly forming on the windward side and dissipating to the lee. There might be up to 10 or more consecutive lenticular clouds downwind of the ridge, each marking another lee wave.

At times, severe turbulence is encountered above the extremely smooth lenticulars (see the turbulence band in Figure 1 above 40,000 feet). This is especially true if a typical jet stream combines with the wave in the upper troposphere. The turbulence layers above and below the lenticular levels are comparable to ball bearings, allowing the atmosphere between to flow through at very high speeds.

Occasionally, a breakdown of the laminar flow sets off a formation of severe turbulence throughout the whole depth of the wave. When this happens, the highest lenticular clouds show very jagged, irregular edges rather than the normal, smooth edges. The turbulence near the tropopause then reaches a degree which might cause structural damage to aircraft.

Figure 2 shows what happened to a glider which flew through this kind of severe high level turbulence. The picture on page 26 was taken during the time the glider was flying. The juxtaposition of very turbulent and very smooth flow, however, is typical in the wave. This was one of the conditions which surprised our pilot.

As indicated in Figure 1, the lenticular clouds in most cases tilt toward the mountain range as ascent is made through the layers from the rotor cloud to the highest lenticular layers. As a consequence of this tilting, the streamlines are packed closer
together in the downdraft side of
rotor. Thus, the wind speed is con
erably increased in the downd
areas and local jets form which in
duce an additional flight hazard
retarding the aircraft in downdr

The mother-of-pearl cloud (u
center, Figure 1) is a rare, high-l
lenticular cloud appearing usuall
the polar regions at about 80,00
100,000 feet under wave conditi
This type of cloud is an indicatio
the enormous vertical extension
horizontal dimensions of a m
tain wave.

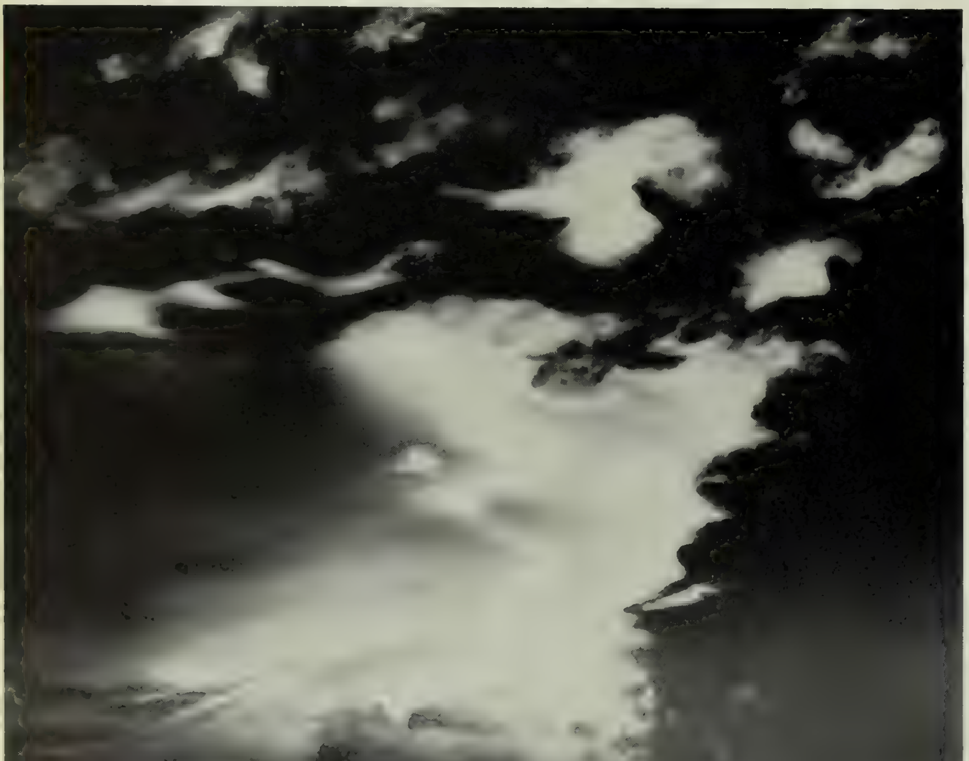
In the Sierra Nevada, for exam
the wave clouds can extend sev
hundred miles parallel to the ri
line with a well-defined leading e
following all bends in the mount
range. These clouds are visible f
great distances and can provide
pilot with a warning of the existe
of wave conditions long before
mountain range is in sight. Our p
did not have enough knowledge of
wave to recognize this warning.

If there are several consecu
wave crests, the amplitude and in
sity of the waves decrease as you
downstream. The distance of the
wave crest from the mountain pe
varies with height and depends on
wind speed, the type of wind pro
and the lapse rate. So does the wa
length (between crests) which is
the order of five to ten miles, oc
sionally more or less. In levels o
30,000 feet the leading edge of
wave cloud is generally directly o
the summits; in low levels, a
miles downwind.

While the overall context of
cloud formation is stationary ove
considerable period of time,
clouds can change position, shape
structure in an extremely short ti
and there is continuously a consid
able amount of motion in and arou
the clouds. Extensive clouds can fo
or dissipate in a matter of minutes

Any mountain range with crests
300 feet or higher can produce
wave. Over low mountains, the w
effect has been observed up to
height 25 times that of the range
the roll cloud is sometimes missi
The intensity of the wave is, in p
a function of the mountain hei
and the degree of slope of the mo
tain range as well as the strength
the flow, all three contributing p
tively to the wave intensity.

**The high lenticulars show very rough edges indicating extreme turbulence at high levels between 32,000 and 42,000 feet. Wind from right to left.**



## The Invisible Mountain Wav

There may be times when meteo

logical conditions are favorable for the creation of a mountain wave, but the lack of moisture in the atmosphere prevents the formation of clouds. This cloudless or "dry" wave is rare but can approach the waves previously discussed in turbulence. It can be dangerous even to pilots experienced in mountain wave flying, since it lacks the warning features that the recognizable clouds in most waves will provide.

Most serious is the case where the wave flow is completely obscured by a thick overcast with low ceiling. The wave is present and might be powerful but it is hidden to the pilot who is occupied with instrument flying.

Additional hazards are present in the form of precipitation and icing. In the opinion of the authors it is practically impossible to penetrate the lower parts of a strong rotor cloud in controlled instrument flight. The majority of accidents in the mountain wave has occurred under these conditions.

### Mountain Wave Formation

The phenomenon of the mountain wave is essentially the same as the flow of water over a barrier which forms rapids and waves downstream. However, the fact that the atmosphere is a gas and that temperature, humidity and wind are changing with height introduces considerable modifications. In the airflow model described in Figure 1 the troposphere consists of two layers. They are separated by a temperature inversion on top of the cap cloud. Consequently, at least two processes work simultaneously:

(a) A "spill-over" of the lower layer shoots down the mountain slope with increasing speed after passing the crestline, at the same time sweeping away pockets of stagnated air in the valley. It then jumps up into the rotor clouds in a manner related to the hydraulic jump of water.

(b) An internal lee wave in the upper layer forms in the wake of the mountain barrier and over the rotor zone.

The interaction of these two effects probably determines the height and position (with respect to the mountain) of the rotor cloud, as well as the amplitudes of the waves. Complications are introduced by the changes of winds with height, and further, by the existence of the stratosphere, basically a third atmospheric layer.

## RULES FOR FLYING THE WAVE

**★ If possible, fly around the area when wave conditions are indicated. If this is not feasible, fly at a level which is at least 50 per cent higher than the height of a mountain range.**

**★ Do not fly high speed aircraft into the wave; particularly, do not fly downwind. Structural damage may result.**

**★ Avoid the rotor (roll) cloud.**

**★ Avoid the cap cloud (foehn-wall) area with its strong downdrafts.**

**★ Avoid high lenticular clouds if the edges are very ragged and irregular, particularly if flying high.**

**★ If flying against the wind, updraft areas, especially the one upwind of the rotor clouds, may be used as an aid in gaining the altitude necessary to pass through the downdraft areas and cross the mountain range.**

**★ Do not place too much confidence in pressure altimeter reading near the mountain peaks.**

**★ Avoid penetrating a strong mountain wave on instrument flight.**

### Meteorological Conditions

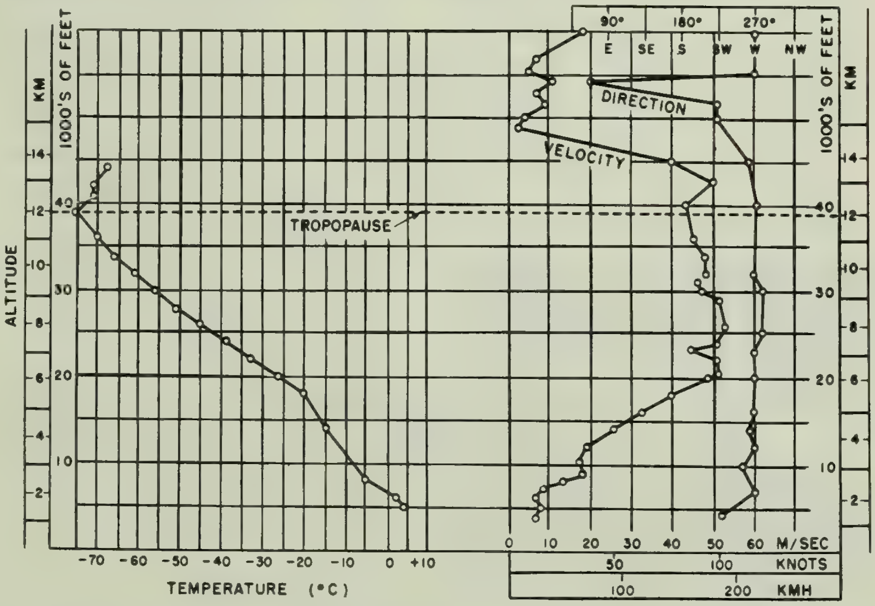
As previously stated, a favorable condition for the formation of a wave is for the wind at the mountaintop level to flow perpendicular to the mountain range. Actually, the wind direction can vary somewhat (50° being the maximum deviation from the perpendicular) and still cause a wave, but the most intensive waves occur with a strong, perpendicular flow. The stronger the flow, the more severe are the effects to be expected on the leeward side.

There is a minimum of waves in summer and a maximum in winter. During the latter season, for example, over a range like the Sierra Nevada, waves can be expected during one out of four days with two or three strong waves per month included.

In the western United States where these waves have been frequently observed, it has been noticed that the strongest ones develop when there is a cold front approaching the mountains from the northwest and a trough aloft approaching from the west. This produces a strong westerly flow over the mountain ranges which have a north-south orientation.

In accordance with the two-layer model of Figure 1 there is generally a stable layer or temperature inversion present on the windward side of the range up to an altitude slightly above the peaks. A pre-frontal area usually includes this condition. The top of this stable layer is just above the cap cloud and dips to its lowest level at a point directly over the downwind foot of the mountain. In

Fig. 3. On the day these charts were plotted a project sailplane soared to a world altitude record of 44,400 feet, with a rate-of-climb which was still over 1000 fpm.



the valley, the winds are frequently parallel to the mountains or even reversed. Without this stable layer, convective instability would tend to break up the wave pattern.

The most favorable wind profile for the existence of a high wave has winds exceeding 25 knots at the mountain top level. There is usually a rapid increase in the wind speed with altitude in the level of the mountain range and for several thousand feet above with a strong, more uniform flow up to the tropopause or higher. The character of the wave varies with different wind profiles. An exceptionally strong increase of wind with height (perhaps from 40 knots at mountain top to 100 knots 5000 ft. higher) can eliminate the wave, leaving only stagnant air in the valley. A strong wave frequently is associated with the jet stream, the zone of strongest wind flow, when the latter is located in the neighborhood of the range. The strength of the flow during such a strong wave may be from 75 to 150 knots in the upper troposphere. In this case one has to watch out for high level turbulence.

The same type of wave pattern as found in the Sierra Nevada has been observed all over the world. In fact, sailplane pilots have made use of these waves as an aid in soaring on all continents for years.

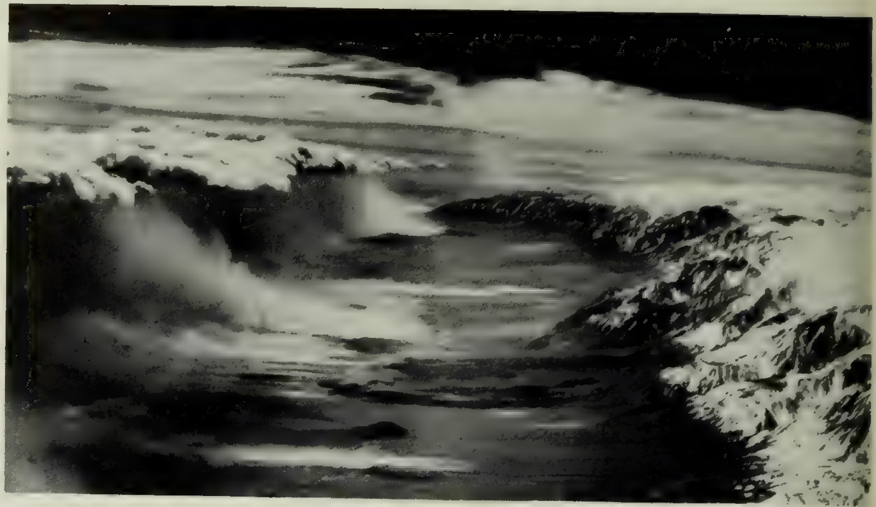
The following is a summary of the meteorological criteria which should serve to alert a pilot to the probability of a mountain wave:

(a) Wind flow perpendicular to the range line and with a speed of more than 25 knots at mountain top level.

(b) A wind profile which shows a strong consistent flow extending several thousand feet above the mountain tops, or an increase in speed with altitude.

(c) An inversion or stable layer somewhere between the mountain tops and the 600 millibar level.

**"Mother-of-pearl" cloud at 100,000 feet.**



**The P-38 from which this picture was taken climbed in the updraft zone from 15,000 to 30,000 feet even though both the propellers on the aircraft were feathered.**

### Hazards of the Wave

The most dangerous feature of the wave is the combination of downdrafts, jet-like winds, horizontal turbulence and altimeter errors. These dangers cannot be stressed too highly. Pilots should avoid direct flights upwind through a full scale mountain wave, either by circumnavigating the area, delaying the flight, or flying at extremely high altitudes.

The downdrafts to the lee of the rotor, and the updrafts below it, can carry a plane into the rotor cloud while a pilot is attempting to pass above or below this cloud.

The best procedure for one caught in the rotor cloud is to nose down to pick up speed and attempt to reach the updraft area in advance (upwind) of the rotor to regain altitude. If the aircraft approaches the crestline of the mountains from the downwind side with insufficient height it will be practically impossible to climb through the jetlike currents near the mountain slope. These conditions, plus the fact that the peaks are hidden most of the time by the cap cloud, make it very likely that a plane fighting strong headwinds at minimum clearance altitude would fly into the mountain peaks.

As the barometric pressure is considerably disturbed in the mountain wave, altimeter errors are associated with the wave conditions. Since the wave is mostly a winter phenomenon, the temperature error in the altimeter reading frequently neglected by pilots contributes to an overestimation of the flight altitude.

The maximum total error possible has been estimated to be about 1000 feet. However, altimeter errors as high as 2500 feet near the mountain peaks have been claimed by pilots although this seems an extreme figure.

Data are not yet evaluated to prove or disprove these figures. At a certain level the maximum positive "altimeter error," indicating greater than actual altitude, can coincide with the downdraft area immediately to the lee of the mountain range, leading to very hazardous conditions. Under wave conditions, pilots should not place too much confidence in their altimeter readings.

Pilots who have the greatest experience in both soaring and flying under wave conditions relate that they consistently lost all control for short periods while under the influence of the roll cloud. They report they have experienced more hazardous flight conditions in the wave than they have encountered in any thunderstorms. In fact, effective gust velocities measured in the sailplanes at heights up to 40,000 feet were of the order of 40 feet per second. This is more than has been measured in the extensive Air Force-Weather Bureau Thunderstorm Project. In wave flight, full controls have to be used to maintain a heading.

Although vertical displacements of aircraft flying downwind through the wave are generally moderate, the turbulence effects may be worse. Estimates show that high speed aircraft (jet class) flying downwind through the rotor zone would experience accelerations which could be structurally dangerous. ●

# 1954

As is our custom, we're tarting off this new year y resolving many wonderful things. And, as is lso our custom, we'll oon forget all about our esolutions. That's just uman nature. But, it's un to think of all sorts of ideas and ideals even if they do spin out of the pattern in short order.

We'd like to suggest one resolution that you'll want to keep forever, even after all the rest fall away, and make this a permanent one. . . .

**PLAN YOUR FLIGHT • FLY YOUR PLAN • FLY SAFELY**

# Mal Function

Mal's recalled to fly again
A real hot rock from way back when

He's ready and off, to the old wild blue
To show these youngsters a thing or two

But planes have grown hotter the past few years
And Mal finds his skills are much in arrears

He snaps on his back, he can think of nothin'
In desperation, hits the panic button

Wild-eyed commander fills Mal with remorse
Too late Mal learns value of refresher course.

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FLYS

# FLYING SAFETY

UNITED STATES AIR FORCE

FEBRUARY 1954

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*In This Issue*
- *A Look at the F-84F*
- *Latest Word on Ditching*

for a long time Captain Hurry
will be losing lots of sleep
fired up and started rolling
bought himself the ramp crew's jeep!

***Look around BEFORE you taxi out!***

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# FLYING SAFETY

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* * *

VOLUME TEN
NUMBER TWO

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* * *

Cover—The new F-84F, now being delivered to USAF units, packs lethal wallop.

An article by test pilot George Welch on spinning the F-86 starts on page 14.

## SUBSCRIPTIONS

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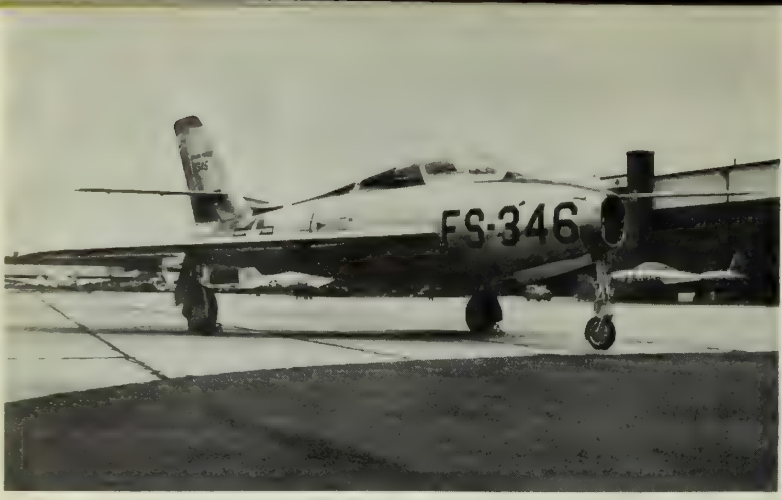


Left, first F-84F off the production line. Test pilot Rusty Roth prepares for initial flight.

# F--AS IN F-A-S-T!

By Russell M. Roth
Flight Test Pilot
Republic Aviation, Inc.

THE best way to learn how to fly an airplane is to fly it. And I believe that the best way to describe a new airplane from a flying safety viewpoint is to detail each step of a flight from walk-around inspection to landing. So, as the pretty gal says on a Saturday night TV program, away we go.

Notice I said new airplane. You jet jockeys who will be flying the Republic F-84F soon will have a completely different bird surrounding you than the old F-84 series aircraft.

The F-84F is a swept-wing fighter designed for flight in the subsonic and sonic speed ranges. It is powered by an axial flow J-65 Curtiss Wright engine, developing 7200 pounds uninstalled thrust. The aircraft lends itself readily to fighter-bomber and long range operations, since it can carry exceptionally heavy external loads.

The cockpit of the "F" was designed with an eye to pilot comfort. It is similar to the 84G, though slightly larger. The pressurization system provides for greater quantities of air at comfortable temperatures and allows cabin pressurization at lower effective altitudes. A double wall canopy, an anti-fogging dry air circulating system and a flat front windshield provide good visibility.

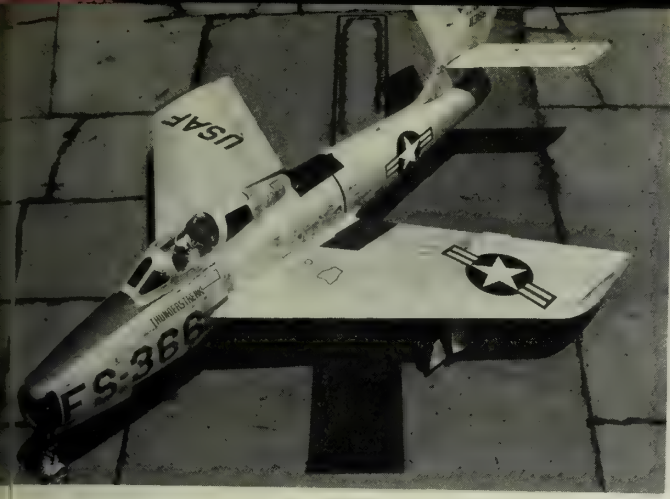
The aircraft is 43 feet long, has a wing span of 33 feet and is 14 feet from the ground to the top of the fin. Gross weight varies from 18,500 pounds for a clean aircraft to over 25,000 pounds for the aircraft with four external tanks installed.

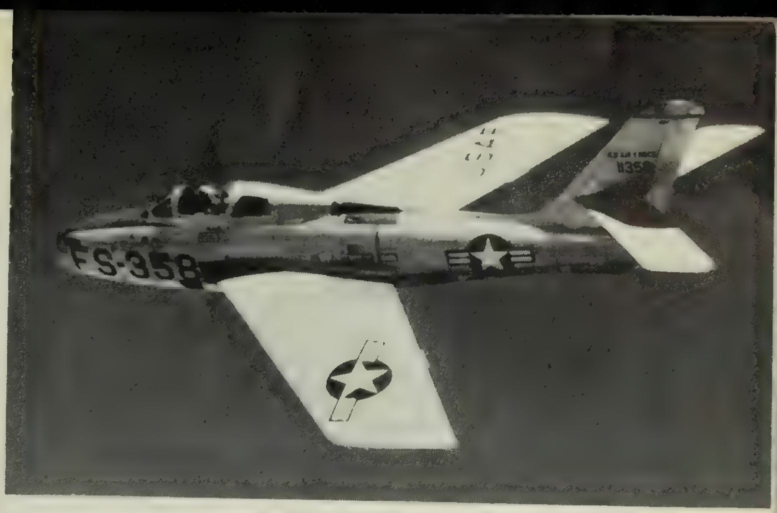
Actually, in discussing the "F," I will refer to two variations of the aircraft. The first planes delivered to the USAF will have two-piece tails. Later, all the planes produced will have flying tails. For simplicity, I will refer to each type as two-piece tails and slab tails.

## Special Preflight Check

During the usual walk-around check list inspection, I note the position of the horizontal stabilizer, so that when I get in the cockpit I can see that the stabilizer position corresponds with the cockpit position indicator. Next, I trim the stabilizer to see that the direction of the stabilizer motion corresponds with the position indicator. At this point also, I check the emergency override switch for travel on the longitudinal control to make sure it by-passes the stick grip.

". . . designed for high speeds at all altitudes; flight characteristics are excellent . . ."





". . . a swept-wing fighter designed for flight in the subsonic and sonic speed ranges."

This aircraft is equipped with an irreversible control system, and all control surfaces are actuated by hydraulic pressure. No air loads or surface forces are felt by the pilot. An artificial feel device as nearly as possible simulates in-flight air loads. With this control system, forces present on the ground are nearly identical to those encountered in flight. Forces are proportional to stick motion rather than airspeed and loading. Don't rely on stick forces; rely on airspeed for proper aircraft control.

For a preflight check after the engine is started and hydraulic pressure is available, deflect the stick full forward, full back and to the side and apply full rudder. If the entire control system is okay, the stick will re-center itself after each control movement and the rudder will return to neutral. In conjunction with this check the artificial feel devices incorporated in the aircraft give you approximately 38 to 40 pounds for full back stick deflection, 12 to 14 pounds for full forward and 18 pounds laterally for full throw. In addition to the above forces, approximately a 1½ pound force is required for initial movement of the stick from the centering detent.

Just before takeoff I arm my jettisoning switches. The inboard jettisoning switch drops the inboard tanks or stores, the outboard jettisoning switch can be used to jettison the outboard tanks or stores, and the panic (emergency salvo) switch eliminates all four tanks and the pylons in case you have to dump them in a hurry on a takeoff emergency.

Before takeoff I run the engine up to 100 per cent and recheck all the engine instruments, particularly the oil pressure, fuel flow, tailpipe temperature and rpm.

On takeoff, rudder breakout forces may cause a slight tendency to overcontrol at the beginning of the takeoff roll. Care and experience will eliminate this tendency after a few flights.

### Watch That Attitude

I would like to emphasize one point concerning takeoff run. I never make any move toward pulling the aircraft off the runway until I have nearly reached takeoff speed for the particular configuration. Naturally I have referenced the dash one for this, prior to starting the flight. When the plane has reached the desired speed range I use a gentle, sustained back pressure to get the nose off and hold a shallow angle of attack. In this attitude, the plane flies itself off the ground as acceleration increases.

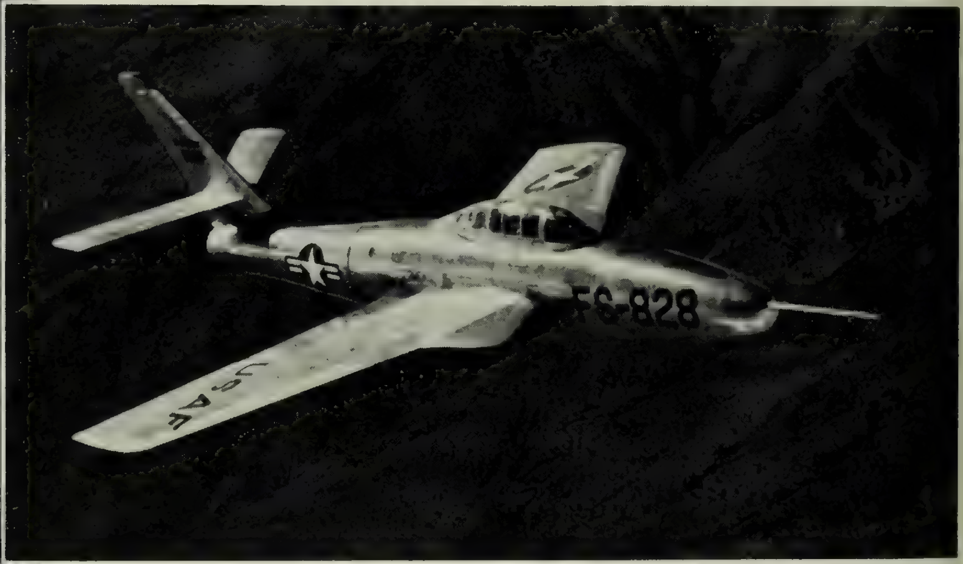
The important things to remember here are airspeed and attitude. If a pilot starts the nose up too soon and holds it off at lower speeds, and he has the elevator power to do this, he stands a good chance of getting on the back side of the power curve, especially with external stores. You all know what happens then. The plane may break ground but it is going to return in a hurry.

Slab tail aircraft have another built-in safety factor. This model has an auxiliary electric hydraulic system which is available to the flight controls. This alternate control system cuts in automatically if the regular system pressure drops below a critical value.

In addition to the normal and the emergency hydraulic systems, an electrical actuator is connected to the longitudinal control system, and the slab tail can be controlled by actuation of the stick trim button. This system by-passes all mechanical linkage and is an excellent battle damage control, as only the electrical wiring from the stick grip to the electric motor in

With the irreversible control system an artificial feel device simulates in-flight airloads.

Below, with jato installed, the aircraft leaps off like a homesick angel. Right, the RF-84F, photo-reconnaissance version of the Thunderstreak on a test flight.



the slab tail is necessary for longitudinal control.

The above control systems actually give the F-84F three separate longitudinal control systems:, regular hydraulic, emergency electrical-hydraulic and direct electrical control.

### Rate of Climb

You jet jockeys will be pleased with the way the aircraft accelerates to climb speed; you get to altitude in a hurry.

Okay, the plane is now at altitude, trimmed and ready to go. Let's run through some of the flight characteristics and see how the "F" handles.

This plane was designed for high speeds at all altitudes; flight characteristics are excellent throughout the speed range. The speed is limited only by the thrust available and by total aerodynamic drag. In level flight at high Mach numbers, the few trim changes are made easily using the trim button to readjust the stabilizer.

Aircraft buffet or heavy trim changes are not problems through the trans-sonic speed range. The aircraft remains stable except for a slight tendency to wing heaviness, which is overcome easily with a small amount of aileron.

Stall warning is very good on both the two-piece tail and the slab tail aircraft. First warning is light buffeting, followed by heavy buffeting, and finally by a softening of the controls immediately before the complete stall. Upon stalling, some nose-up tendency is noticeable, but there is sufficient longitudinal control to stop it. In fact, in the slab tail models there is far more control available than ever could possibly be needed.

When the aircraft is stalled there is a pronounced yaw, usually to the left. This gives an additional stall warning. This tendency is no cause for sweat on a landing, as plenty of rudder control is available to correct the yaw before touching down. When the aircraft yaws, just remember the plane is ready to pay off.

On any stall, accelerated or unaccelerated, the 84F comes out flying, with no tendency to spin. This is equally true for aerobatic maneuvers. In fact, to spin this plane, a pilot would have to make a deliberate entry and then hold the plane in the spin. To date, spin tests haven't been run and the F-84F is restricted from spins. Wind tunnel tests with a scale model F-84F have been accomplished and the "F" displayed normal aircraft spin characteristics.

After going through the usual aerobatic maneuvers and observing how well the plane handles, let's go downstairs and see how it handles at low altitudes and on a landing.

### Low Altitude Dives

A word of caution for you boys who like to play downstairs at high speeds. This aircraft accelerates rapidly and can really wind up. A word of explanation from our engineering people as to what can happen if you get too gay might help at this point.

A high speed aircraft loses some of its control effectiveness in the vicinity of and above .9 Mach number so be

careful. The point is, don't get in the wrong attitude *at any altitude* where control effectiveness is essential.

In an emergency some help can be obtained by judicious use of the stabilizer trim. However, be extremely careful about overloading the airplane. As airspeed decreases, control effectiveness returns, and if excessive trim has been applied, high accelerations may be experienced. Use full elevator travel before applying stabilizer trim, so that full opposite surface travel will be available in case you pull excessive G.

I'd like to stick my neck out a little bit in discussing landings. I think it is almost impossible to make a bad landing in this airplane. Okay, I know some joker will make a liar out of me, but he is going to have to try real hard. I just don't believe that today's high performance jet aircraft, and I mean all of them and not just the F-84F, can be flown safely in the landing pattern if the pilot insists on wracking around in steep, tight turns. I don't mean that you have to fly a "goonie bird" pattern to be safe; just a modified pattern with normal turns and power.

Although I could quote some figures relative to pattern speeds that generally apply, I believe you should reference the dash one and thoroughly memorize them all. Inasmuch as a definite pattern is a must on my books, I make my break and bring the plane around smoothly for the downwind. Then the gear and flaps are lowered while holding the recommended speed. I prefer to maintain a good margin above stalling until on final and then begin slowing down as I cross the end of the runway, using a shallow approach. I retain power until I have it made, as this aircraft has a high rate of sink.

## Airspeed and Power

I still say that you really have to try to make a bad landing. The point is, control your rate of sink with power and sufficient airspeed and there's no sweat. True, the rate of sink may be deceiving to an inexperienced man, as the plane feels good and solid until he looks out and sees the ground coming up real fast. Then when he comes back on the stick, there is no round out left. Remember airspeed and power, and the problem is non-existent.

Russell M. "Rusty" Roth, Republic Aviation test pilot, has made many of the test flights on the F-84F prototype and production aircraft. He has over 1000 hours in jets included in his 2500 hours fighter time, with 400 hours in the F-84F alone.

Roth became a test pilot at Republic in 1951 after eight years as an Air Force pilot. Six years of his service in USAF were spent as a pilot in the Flight Test Center at Edwards, after a combat tour of the SWPA in P-38s.

After touchdown a pilot has plenty of braking action to bring the plane to a stop. In fact, it is easy to slide a wheel with the power assisted brakes and not even know it. I try to get the nose down fairly early in the roll and start light brake application immediately, rather than wait too long and then be forced to use too much.

In case a landing is made deadstick, engine frozen or with hydraulic pressure not available, the brakes are on a hydraulic-mechanical system. Brake forces are high, but full action can be obtained, even to sliding the wheels.

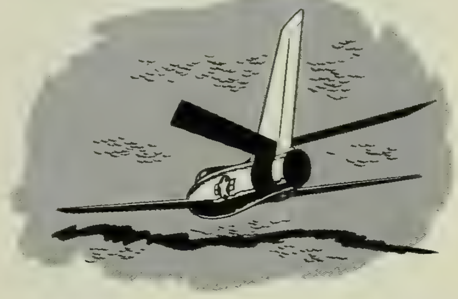
The F-84F can carry a tremendous load of external stores and still get off well. I think both takeoff and landing run compare favorably with other aircraft, especially considering the weight that can be carried.

I have made flights with the airplane in an asymmetrical configuration, with the equivalent weight of a full 230-gallon inboard pylon tank on one side. Landing in this configuration presents no problem; at slightly above normal approach speed with gear down and full flaps there is still enough aileron for lateral control. However, in case an outboard tank is lost, I recommend dumping the other before landing.

As an added safety factor on the two-piece tail aircraft a factory test is flown on each plane with boost off. This test is made to determine at what maximum speed the aircraft can be controlled safely with boost off. This precludes the possibility of getting an aircraft so out of rig that it can't be controlled at higher speeds. Ordinarily, when flying with boost off in the upper speed ranges, the aircraft has good rudder control and fair elevator and aileron control. All flight control in the lower speed ranges is very good.

I suggest that, as a flying safety measure, all new F-84F pilots practice flying the two-piece tail model with the boost off. This will enable them to find out just what the aircraft will do under this condition and to familiarize themselves with the changed control characteristics. To practice booster-off flight, trim the plane for straight and level flight in the mid-speed range and turn the system off. When ready to turn the boost system on, re-trim aircraft to reduce high stick forces. Incidentally, on the slab-tail model this is not a problem as it has an auxiliary control system.

In writing this article I tried to mention some of the F-84's features and some of the things about the aircraft that deserve your respect when flying it. To sum it all up I would say this is a fine aircraft; big, fast and rugged. It will do the job for which it was designed, and do it safely and well. I think you'll like to fly it; I know I do. ●



*Captain Burdon L. Davidson, the Wing Flying Safety Officer from Ladd AFB, dropped in to see me the other day. We had quite a chat after he parked his snowshoes and divested himself of his parka and mukluks. Seems that one of his pet projects centers around the Air Force version of the Alaskan bush pilot. He's really got 'em up at this base. Guys that leap off into the murk when the birds are walking and the polar bears are hibernating.*

*Unlike most of our visitors, Captain Davidson came loaded for bear (force of habit, undoubtedly). He had a ream or two of facts, figures and photos. "This is the way we operate," he said. "Look it over and see if there isn't a story here for FLYING SAFETY." After reading it, I agreed, and dispatched it post-haste to Flying Safety Magazine.*

# BUSH PILOTS -- USAF Style

### 1st Lt. John A. Piganell, Ladd AFB, Alaska

CIRCLING over a pioneer "bush" strip at one of the remote satellite bases in Alaska, a C-47 pilot eyes the match-like landing field cautiously. It runs up the side of a mountain; the approach comes through a valley between other mountains, and a blanket of snow covers the runway. The pilot has been here many times before, still, each time he returns it looks impossible.

On the ground a hundred expectant faces turn upward. To them the C-47 means vitally needed cargo, mail and replacements. It is their main and often only line of supply. To them the "Old Gooney Bird" means success or failure, good living or poor existing.

The heavily loaded C-47 starts down the long final approach, almost obscured by the mountains. Every bit of knowledge ever learned and a hundred new techniques are called upon by the pilot. His judgment must be perfect the first time, for there is no go-around through the towering mountains.

The lumbering C-47 touches the hard packed snow and bounces slightly, but even before the tailwheel touches the ground, the pilot applies almost takeoff power to taxi up the sloping runway. Another load of life and defense has arrived.

Bush flying, one of the most hazardous of operations, calls for the ultimate in flying skill and a constant awareness of safe procedures. Not only must the bush pilot fly in suc extreme temperatures as 50 degree below zero and land on extremel short rough strips, but he must als navigate over tractless wastes of Arctic tundra with few or no navigationa aids. Radio ranges are few and fa between north of the Alaskan Mountains and often are unreliable.

With airframe ice, heavy turbulence and icy runways almost dail threats, the bush pilot is confronte further with unusual conditions suc as white-outs, severe downdrafts an high winds. A white-out is peculia to the Arctic regions in winter. Wit visibility unlimited a pilot flies instruments because the high overcas blends with snow-covered tundra causing the horizon to disappear.

In the small, scattered outposts of the bleak Arctic the bush pilot is all-important.

During the spring the thaw causes gaping holes in the runways. The melting snow seeps through the hard packed dirt, and the runways become slick and dangerous.

Spring and fall bring the worst weather. Low overcasts and heavy icing conditions are encountered more often than not.

Summer weather is a relief, but Alaskan summers are short and over before the bush pilot can enjoy the good weather. Winter and its subzero temperatures, snow, ice, fog and long hours of darkness keep him busy.

Every pilot, realizing the importance of airlifting supplies, realizes also the unusual conditions involved. These Air Force bush pilots carry with them on every flight personal survival kits, along with bailout kits and survival gear issued by the Air Force. In the event of a forced landing or bailout these pilots know it may take days or weeks before help arrives. Unlike the States, the nearest phone is not just down the road. There is no road.

To show its appreciation for safe flying during unusual and extreme conditions while delivering vitally needed cargo to satellite bases, the 11th Air Division has instituted a "Master Bush Pilot Certificate." This coveted award is earned only by pilots to whom flying safety is a byword.

During a typical three-months period, 11th Air Division pilots airlifted almost 2000 tons of cargo and flew over 3000 hours. This impressive record is the pride of every pilot in the 11th Air Division. To these men who must perform a dual job of working at their desks and flying tons of cargo per year go the admiration and appreciation of the 11th Air Division.

Good news for troops; supplies, mail and contact with outside world arrive with bush pilot.

The "Master Bush Pilot Certificate" is a project of Capt. Burdon L. Davidson, Flying Safety Officer, Ladd AFB, and is to be awarded to those pilots whose desk jobs are supplemented by secondary and vitally urgent flying jobs. These desk jockeys are required to fly two days per week and fulfill the following conditions.

To be awarded the certificate, a pilot must "first-pilot" an aircraft into most of the satellite bases within the 11th Air Division Command, fly 300 or more first pilot hours in the Alaskan Air Command and not be involved in an aircraft accident while in the theater.

How does an Air Force pilot become a bush pilot? Regardless of the number of hours a pilot has behind him, he must begin anew for this peculiar operation. First, with an instructor pilot he must be route-checked into the remote satellite bases. He observes several landings from the right seat at these bases then makes two landings on each of the bush strips.

If he has shown good judgment and safe procedures, he becomes first pilot. But before he is turned loose, he must have either 1000 hours total first pilot time and 200 hours in the C-47, or 2000 hours total time and 100 hours in the C-47.

This is by no means the end of his bush training. Through a well organized flying safety program and an Arctic Flying Indoctrination School, the newly arrived pilot learns the added techniques of safe flying in the Arctic. The many fine points learned through years of experience in bush flying, those points that mean the difference between landing safely under extreme conditions and crashing, are called to his attention. The old timers give him more information about the peculiarities of each bush strip. Every day and every flight are a constant training program, and only when the pilot rotates two years later with an accident free record, can he say he is an accomplished bush pilot.

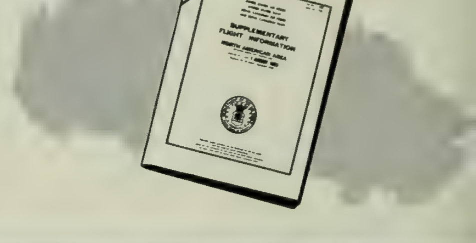
Maintaining proficiency in flying into the bush strips is the responsibility of the pilots, even though they must hold down desk jobs.

Brig. Gen. Donald B. Smith, Commander of the 11th Air Division at Ladd AFB, Alaska, has indorsed the "Master Bush Pilot Certificate" because of the incentive created among the pilots to deliver cargo and personnel to the satellite bases of his command efficiently and safely. ●

# SUPPLEMENTARY FLIGHT INFORMATION

Lt. Col. Robert L. Van Ausdall
Senior Air Instructor
Maryland Air National Guard

**There is a wealth of information between the covers of the SFI and it's put there for your use.**



The author, right, believes the multitude of facts in SFI tie in directly with flight safety.

The careful pilot makes use of the information that is provided for his benefit in the SFI.

*A publication which is more readily available and yet probably least used by pilots is the Supplementary Flight Information document (sometimes known as **SFI**).*

*This document can be directly tied into flying safety because of the multitude of facts it contains. Facts which have saved many lives in the past. Facts which may save **YOUR** life sometime in the future. Do you know what information is available to you in this fine book? This article will brief you on some of the facts.*

HOW many times have you heard a pilot over **"BRAVO"** Channel ask the tower, "When does official night time begin?" or "What is the correct time?"

How many times have you searched for the latest AFR 60-16 to clarify a procedure or to re-check your takeoff minimums or the requirements for an alternate airport?

Do you remember the requirements for fuel reserve?

Do you know where you can quickly learn the location of Air Rescue Service Units? Of Regular Foreign Clearance Bases?

The answer to all of these and to hundreds of other procedures are easily found in the Supplementary Flight Information document.

The Supplementary Flight Information document begins with a set of conversions; listing barometric readings from inches to millibars, Centigrade degrees to Fahrenheit, barometric inches to altitude and nautical miles to statute.

This set of conversion factors is followed by a Sunrise and Sunset Table for given latitudes and any meridian. Time signals and standard frequencies of WWV and WWVH are listed with an explanation of how to receive the exact time by radio while airborne. A group of Navy Time Signal stations and their frequencies are also shown. These signals are absolutely reliable to 0:05 second.

One of SFI's main uses is to supply a list of commercial radio stations for every state in the United States. But no station listing will be found for any U. S. locality for which there is no record of an airport. For cities with more than one radio station the most powerful station or that station which maintains the longest hours of operation is usually shown.

In these days when economy cuts and new trends in navigational equipment are forcing the closure of several CAA Radio Ranges, the use of this section of the SFI will increase. For each radio station, remember that there will be a column listing hours of operation, magnetic bearing and distance to the airport.

Broadcast Stations are likewise listed for Alaska, the Azores, Bermuda, Greenland and Iceland plus a complete listing of *all* stations operating in Canada.

**QUQUG** or **QILIO** are examples of ICAO NOTAM coding. Such coding is somewhat familiar to most pilots. Most of them know they can find the key somewhere in a weather station or in base operations but how many of them know the key is located in its entirety in the Supplementary Flight Information document? This code can come in very handy on numerous occasions. For example, at locations such as some Air National Guard bases or P fields where CAA facilities have weather sequences, there may not be someone handy to decipher the NOTAMS for you. These NOTAMS are most important in the winter months in advising of runway conditions in areas of ice and snow or freezing rain.

Your SFI contains an explanation of direction finder service. It gives HF VHF/UHF procedures and explains how a DF works. It tells a pilot the various classes of steers; the proper phraseology to use; how to alert DF stations; how to contact F.C.C. D/F stations, and how fighter aircraft with An/ARA-8 VHF D/F (better known as the "Dog-Uncle" homer) can home on ground stations.

Do you, as a pilot, know what CIRVIS means? CIRVIS is *C*ommunication *I*nstructions for world-wide *R*eporting of *V*ital *I*ntelligence *S*ightings from aircraft. Who reports, what to report and how to report are clearly covered in SFI.

International procedures for such things as altimeter settings, communication distress, position reporting, radiotelephony and units of measures are covered in a section of SFI called General Procedures. This chapter which would be of most value to an aircraft on an overseas flight also covers ICAO charts and place-name abbreviations, ocean station vessels, meteorological broadcasts, ADIZ Areas with their coordinates, designated mountainous areas and other matters of a general scope.

### ATC Procedures and Regulations

If you are one of those pilots who has to sweat his way through the written portion of an instrument check once a year, next time pick up this chapter in the SFI document and read it, or better yet, study it. You'll find numerous answers and explanations, definitions and even a copy of AFR 60-16 contained here. Also included are the 60 series of Civil Air Regulations, covering rights-of-way, acrobatic flights, minimum safe altitudes, airspace restricted areas, radio failure, visual flight rules and instrument flight rules.

Believe it or not, there is even a section devoted to the USAF procedure for making a radio range orientation, with easy-to-read diagrams. Another page diagrams standard holding procedures. ILS, GCA, Flight Service, Flight Plans, Air Traffic Control and Approach Control are all defined and explained in plain language.

That's not all! A page is devoted to standard light signals and the uniform system of hand signals for parking. Another to in-flight and post flight weather reports and pilot to forecaster service. Still another to two-way radio failure and servicing.

### Emergency — Rescue

This is it! *EMERGENCY* is the chapter which is so seldom read until it is needed. Then it becomes the most important bit of print that ever hit a page. If you ever find yourself on the wing of an aircraft that you have just bellied in away out in the boondocks and you wonder just what you should do next, reach in and pull the Supplementary Flight Information document out of the chart case and read the chapter on *EMERGENCY*. Air Rescue Service and the location of ARS Units are explained. Recognition of emergency visual and radio signals, body signals, mirror emergency signals and standard aircraft acknowledgments are in diagram form. An international ground-air emergency code, Paulin signals and parachute signals round out a full chapter of how to save your life.

This article is only a briefing on the Index of the SFI. But were you one of the many who have been unaware of some of the things contained in SFI? If you will take one more step and reach for the nearest SFI and review it, you can refresh your memory on many more interesting facts. Perhaps when the time comes you can save your life or that of someone else through the use of this little used book. ●

**There apparently is a spark of genius in every man and we find that even the newer members of the team often crop up with some mighty sound ideas.**

*Two recent inventions bear out this thinking. The first, a rapid fire flight computer, was sent in by Capt. Larry M. Killpack of the 526th Fighter-Bomber Squadron. After reading this one-pager you'll agree that Captain Killpack has done a bang-up job for the Air Force.*

*The next two pages are devoted to the brain-child of 1st Lt. George M. Boyd of the 318th Fighter-Interceptor Squadron. His idea may well save many lives and dollars. Both men deserve a salute from the troops for their initiative and ingenuity.*

# Spin AND Win

### By
### Capt. Larry M. Killpack
### 526th Ftr.-Bomber Squadron

Capt. Killpack checks out a fellow squadron member on use of computer for a cross-country.

CAPTAIN Killpack was informed that his organization was soon to receive F-86's and this set him to thinking that a range computer comparable with that for the F-84E would prove of extreme value to the organization. Accordingly he went ahead on his own, and after four months of work, produced the computer seen in the accompanying photo.

Captain Killpack claims no credit for the design of the computer inasmuch as it was patterned after one developed for the F-84E by personnel at the Air Proving Ground, Eglin AFB. We can't quite agree with his thinking, however, for by revamping the computer he made it possible to have the latest flight data immediately available. In addition, he scheduled numerous flights himself in order to supplement existing flight data and arranged this information so that it would be easily and accurately available by a twist of the wrist.

One of the things immediately noticeable about the computer is its construction. It is home made but has the look of a professionally manufactured article. Captain Killpack investigated the possibilities of commercial fabrication but found the cost prohibitive. His experience in amateur photography provided the solution. He had four-inch black and white prints made of the rotating faces of his master computer and 4¾ x 6¾ inch prints made of the stationary faces. Next, he utilized a flat-iron to iron the prints to stencil paper, using Kodak Dry Mounting Tissue as the adhesive. Following this step, scissors and razor blades were used to round the faces and cut the windows. The parts were then taken to the parachute shop, where they were matched and riveted together.

That's about all there was to it. The end result was a mighty fancy range computer that most anyone could make for a total cost of approximately 25 cents.

Naturally this little gem isn't quite as desirable as one made from plastic but most pilots have included one in their letdown books and thus protected, should last for several years.

On querying personnel concerned as to the reliability of Captain Killpack's computer, we were informed that on the farther-faster side of the computer, some inaccuracies were found at different cruising speeds.

For flights of several hundred nautical miles about five per cent more fuel was used than the computer indicated for expected consumption. However, as range was increased, the errors at different speeds decreased until they were negligible. The data on the climb and descent face have proved to be correct if the climbs and descents are properly controlled.

Members of Captain Killpack's organization feel that his contribution has added greatly to the effectiveness of the group.

We of FLYING SAFETY also tip our hats to Captain Killpack. ●

# DIAL-A-BASE

**1st Lt. George M. Boyd**
**318th Ftr.-Intercp. Sq.**
**APO 23, C/o PM, New York**

WHEN I was at the Air Force Radar Observer School down at Waco, I realized I was pretty weak in navigation. I kept asking myself, "If you can't find your way around in a B-25 at 205 IAS, how can you navigate at the greatly increased airspeeds flown in an F-94?" It was quite a question and I gave it a lot of thought.

In fact, I thought about it all during my hassle with radar down at Tyndall. After graduation I moved up to McChord AFB. By then I had come up with what I thought was the answer—a gadget I call the Dial-A-Base.

The Dial-A-Base is intended as a navigational aid for all weather operations in local areas. It incorporates, in compact form, the principles of radio facility charts and of current area maps. It facilitates rapid location of an alternate in case of an emergency in jet aircraft. With the realization that time is of prime importance during any in-flight emergency, and particularly in jet emergencies, I included on the Dial-A-Base that information which aircrews must have quickly in an emergency.

The Dial-A-Base pictured here was designed for the local flying area around McChord Air Force Base. McChord is the center of the radius of action. However, the gadget is readily adaptable to any locality. In addition to being useful during emergencies when rapid selection of an alternate is necessary, the Dial-A-Base, if used in the local area during other than emergency conditions, will help flight crews to become more familiar with local facilities and checkpoints. Personnel flying aircraft which carry electronic equipment that assists in navigation may make good use of the side of the wheel devoted to unit navigation.

**Lt. George Boyd points out how "Dial-A-Base" can be used as emergency safety insurance.**

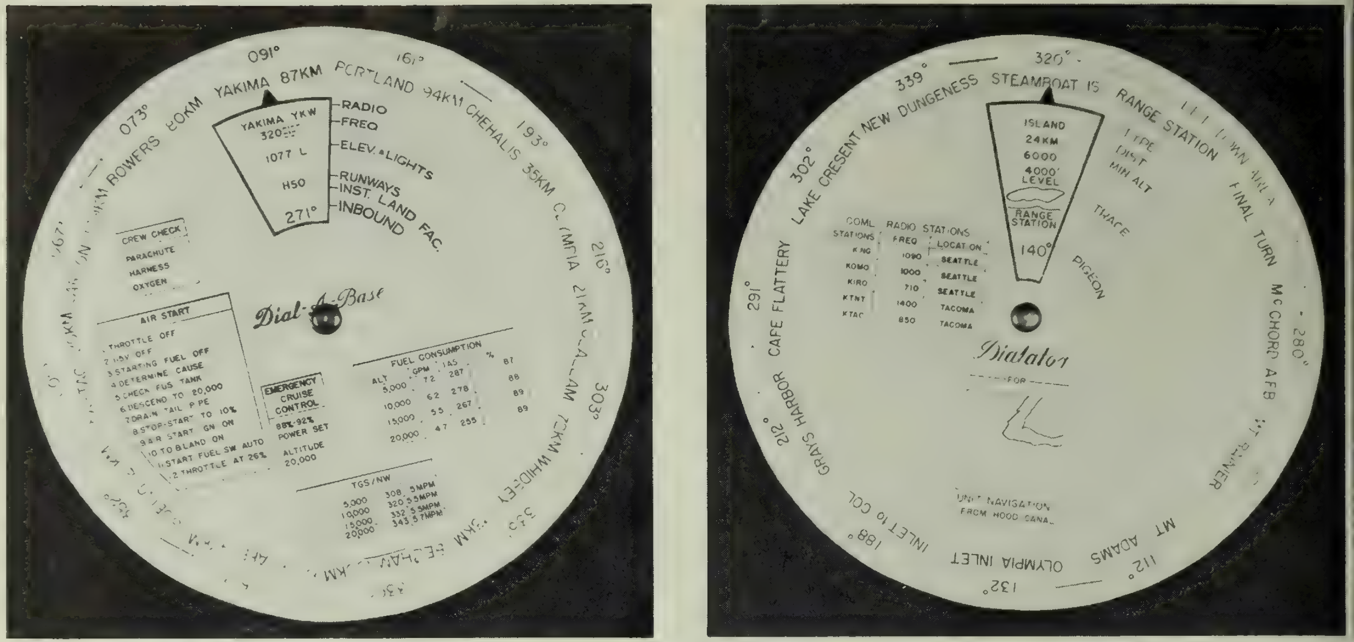
Possibly pilots and observers at other bases might find a local Dial-A-Base helpful. See what you think of it.

Designed to the configuration of a navigational computer, the Dial-A-Base is about six inches in diameter and fits nicely in the breast pocket of a flying suit. It is composed of three revolving discs or wheels similar to the circular slide rule. The side labeled "Dial-A-Base" is printed with the major emergency procedures and has a window for reading the facilities information pertinent to the installation dialed. The middle wheel is divided into 12 segments, representing 12 air bases (military are in black, civilian in red) which may be used for landing in case of emergency. The necessary field information is listed in standard AF Flight chart form, and includes:

- Outbound headings from McChord AFB, in numerical order.
- Name of installation.
- Nautical distances from McChord.
- Radio name and frequency.
- Field elevation and lighting facilities.
- Runway surface and length.
- Inbound headings, in numerical order to McChord.

The reverse side of the wheel is devoted to unit navigation and includes approximate outlines of 12 checkpoints to aid observers and pilots in determining location and to assist pilots in navigation. After dialing a checkpoint, you read through the window:

- Outbound heading from Hood Canal (orbit point).
- Name of the checkpoint.
- Kind of checkpoint (lake, inlet, island).
- Nautical distance from Hood Canal.
- Minimum altitude for safe navigation over the checkpoint to or from Cape Hood.
- An outline picture in green of size and shape (on course) at 20,000 feet altitude.
- Inbound heading to Hood Canal.



**Left, one side has major emergency procedures and a window to read facilities information pertinent to base dialed. Right, reverse is devoted to unit navigation. Below, mileage chart gives distances, vectors to bases.**

| NAUTICAL MILEAGE CHART | BELLINGHAM | BOEING | BOWERS | CHEHALIS | CLALLAM | LARSON | OLYMPIA | PAINE | PORTLAND | SEA-TAC | WHIDBEY | YAKIMA | NAUTICAL MILEAGE CHART |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 76 | 135 | 129 | 56 | 161 | 111 | 55 | 193 | 82 | 28 | 158 | BELLINGHAM |
| | 76 | | 79 | 59 | 60 | 122 | 42 | 23 | 117 | 7 | 51 | 93 | BOEING |
| | 135 | 79 | | 104 | 138 | 49 | 97 | 90 | 122 | 77 | 118 | 28 | BOWERS |
| | 129 | 59 | 104 | | 90 | 153 | 18 | 80 | 67 | 55 | 102 | 102 | CHEHALIS |
| | 56 | 60 | 138 | 90 | | 178 | 73 | 51 | 156 | 64 | 37 | 153 | CLALLAM |
| | 161 | 122 | 49 | 153 | 178 | | 147 | 128 | 166 | 122 | 152 | 63 | LARSON |
| | 111 | 42 | 97 | 18 | 73 | 147 | | 62 | 84 | 38 | 83 | 100 | OLYMPIA |
| | 55 | 23 | 90 | 80 | 51 | 128 | 62 | | 140 | 28 | 31 | 109 | PAINE |
| | 193 | 117 | 122 | 67 | 156 | 166 | 84 | 140 | | 112 | 164 | 114 | PORTLAND |
| | 82 | 7 | 77 | 55 | 64 | 122 | 38 | 28 | 112 | | 56 | 90 | SEA-TAC |
| | 28 | 51 | 118 | 102 | 37 | 152 | 83 | 31 | 164 | 56 | | 138 | WHIDBEY |
| | 158 | 93 | 28 | 102 | 153 | 63 | 100 | 109 | 114 | 90 | 138 | | YAKIMA |
| **NOTES** | | | | | | | | | | | | | |

The Dial-A-Base can be constructed on any light, semi-pliable material readily available on the commercial market. The red, green and black ink used should be a kind that is plainly visible under different types of cockpit lighting.

To accompany the computer, a mileage chart (in nautical miles) was devised, giving distances and vectors for the stations listed on the Dial-A-Base. This is a sliding device which may be attached to the computer, and includes a space for listing flight plans.

A little test was set up in our squadron to show the effectiveness of the computer and the attached chart. One crewmember was given a radio facility chart and a local area map. Another was given the Dial-A-Base. The second man figured his alternate base, vector and distance in 20 seconds while the officer with the chart and maps was still hunting through the index.

After the Dial-A-Base had been put into use, one of the squadron members came up with an idea for a plotting board to be attached to the back of the radar operator's console. This board can be removed or left attached, as the radar observer wishes. Location of fighter and target aircraft can be plotted on the board's plexiglas face. Each board has a grease pencil attached. The map is sandwiched between the face and back of the board and can be changed at will. The local area map is oriented according to variation (which was —22 degrees E in this case). All headings given can be flown without conversion, minimizing human error.

It looks as though the policy of having the radar observer act as navigator and attend all briefings with his pilot is a worthwhile one. The guy in the back seat is not helpless. He can take a big load off the pilot's back by knowing what's going on in and around the aircraft. Radar navigation is invaluable in case of radio failure or bad weather. In our squadron, pilots are directed to let the radar observer talk them down with airborne radar.

The Dial-A-Base and the plotting board, as I have described them, work extremely well for us. They look to me like extra life insurance for the pilot and radar observer. And for the taxpayer, they can be money in the bank. If the ideas appeal to you, try them. The time and expense involved is small. And you may get big results. ●

# WELL DONE!

## 2d LT. FREDERICK E. GRIFFITH

### 64th. FIGHTER INTERCEPTOR SQDN.

Lt. Frederick E. Griffith earned his Well Done commendation when he was able to prevent possible injury to his observer and himself and to save an F-94 from total destruction through his outstanding airmanship and flying technique.

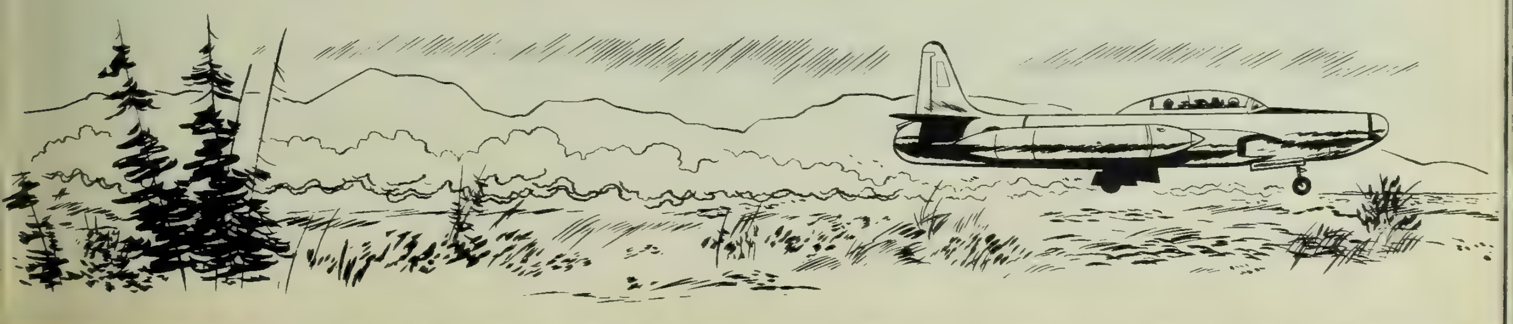
Lt. Griffith was on a routine instrument training flight at 17,000 feet when, ten minutes from the base, his generator warning light came on and his loadmeter read zero. He was unable to return to Elmendorf as this necessitated making a letdown through 9000 feet of overcast with instruments that might fail at any minute. He turned south as the weather briefing had indicated that cloud cover in that area would be scattered to broken.

After flying for a quarter of an hour on the new heading a break in the undercast was discovered, but it was too small for a VFR letdown. At this time the tips ran dry. Griffith kept the fuselage tank filled by periodic use of the internal fuel tank switches. However, he was not certain how long output from the battery would be sufficient to keep the fuselage tank filled.

At this time another break in the undercast was sighted and Griffith decided he would have to complete his letdown through it or bail out. After getting down between cloud layers he finally broke out at 1000 feet. A search was immediately made for a suitable forced landing area. Several clearings were sighted but Lt. Griffith decided to keep searching while fuel remained.

He had picked a clearing when he noticed a road and decided to follow it hoping it would lead to a building that could be used for shelter. In following the road he located a radio range and shortly thereafter a short landing strip.

Lt. Griffith decided to make a wheels-down, short field landing and, if necessary, retract the gear if he ran off the strip. On final approach he had insufficient battery output to lower his flaps. Despite this, Griffith made a safe landing on the 3500-foot strip, stopping 75 feet from the end, with no damage other than a blown tire.



# Spinning TH

*The following article on F-86 spin characteristics is the most up-to-date information available.*

*FLYING SAFETY will continue the policy of bringing its readers the latest information on current USAF aircraft and their characteristics as rapidly as possible.*

★ ★ ★

IT is mid-afternoon as an F-86F airplane prepares to take off. The test pilot's schedule indicates that today he is to practice spin recovery. If you were that pilot, would you have any questions on the spin recovery characteristics of the F-86F?

Probably not, for you know that the F-86 airplanes have consistently demonstrated their ability to recover from any type spin using the standard recovery procedure or the hands-off method. However, maybe in the back of your mind a little doubt still persists; maybe you remember hearing about an accident which indicated that an F-86 was lost because of failure to recover from a spin.

# SABRE

George S. Welch
Senior Test Pilot
Engineering Flight Test
North American Aviation, Inc.

★

**First man to fly the F-100 Super Sabre at supersonic speeds in level flight, Welch has been testing North American planes since 1944. Prior to that time he was a major in the U. S. Air Force.**

**In 33 months of combat service in the Central and Southwest Pacific during World War II, he won the Distinguished Service Cross, Distinguished Flying Cross, Silver Star, Air Medal and a Presidential Unit Citation.**

**During this service he was credited with shooting down 18 planes, four of which were bagged over Pearl Harbor when he and one other officer were the only pilots from his field able to get in the air that day.**

**At North American he has made first flights with the F-86 Sabre Jet fighter series A and E, the F-86D Sabre Jet interceptor, and the YF-93, in addition to the YF-100 in which he exceeded the speed of sound in level flight on the first test run.**

★

Loss of an F-86 in this manner is somewhat puzzling, to say the least. The factory, in over 100 actual spin tests has never been able to find an F-86 series airplane that would not recover from any type spin.

On page 17, you can follow a pilot through two spin tests. In one, the spin is entered from a normal, upright one G stall; in the other, the spin is entered from a three G climbing turn.

As an example of the extent of factory flight and wind tunnel spin tests, F-86s equipped with the slat or extended leading edge have demonstrated their spin characteristics in all of the following situations: In both clean and drop-tank configurations; with flaps and gear down and with flaps and gear up; both erect and inverted at low speed; ailerons neutral, against and with the spin; with speed brakes open and closed; power on and power off; forward and aft center-of-gravity positions, and out of accelerated stalls at low speed and at Mach .9 (snap rolling).

Factory test pilots who have had extensive F-86 flight time say they have never experienced any kind of spin or spinning maneuver from which recovery could not be accomplished by use of the standard recovery technique. In fact, the pilots report that it is difficult to keep an F-86 in a spin.

For example, to maintain spins entered by snapping out of a high Mach number turn at altitude, a stick pull force of 50 to 60 pounds and a rudder force of 200 pounds are required from trimmed level flight. Thus, the test pilots are convinced that merely neutralizing the controls is sufficient to effect spin recovery, although recovery in this manner may take an extra turn to complete. Therefore, it is concluded that in all non-spin-recovery accidents reported, the wrong recovery procedure was used.

One factor that may be contributing to the use of the wrong spin recovery procedure for the F-86s is that potential jet pilots receive their training in the two-place T-33 trainer.

The T-33 has different spin characteristics than the F-86 series airplanes. In a recent article in Flying Safety Magazine on the correct spin recovery procedure for the T-33, it was specified that once the airplane is in a spin, the throttle should be in idle position, with the ailerons held in neutral but with *the stick held full aft.* The article went on to state that a smooth pressure should be applied to the rudder against the spin. Finally, after spin rotation stops, back pressure on the stick should be released. It further cautioned that popping the stick forward might throw the airplane into an inverted spin.

The spin recovery of the F-86A, D, E and F series is quite different from the procedures learned for the T-33 trainer. To recover from a spin in the F-86, the pilot must release all controls, or he may kick hard opposite rudder and move the stick forward to neutral simultaneously if a quicker recovery is desired. It is MOST IMPORTANT NOT TO HOLD the stick in the aft position after opposite rudder is applied, as this results in a spin in the opposite direction.

All pilots should remember that they have a "flying tail" which is powerful enough to hold the airplane stalled and in a spin, regardless of rudder manipulation, if the stick is held back. Spins have been entered and recovery completed with the throttle positioned at Military Power; however, retarding the throttle to idle reduces altitude loss during the spin.

Inverted spins may occur if the airplane stalls during aerobatic maneuvers. The inverted spin is characterized by a roll into a normal 45-degree dive during every three-quarters of a turn. Recovery can be initiated at any time by neutralizing controls and dropping the nose as the airplane rolls upright.

When spin entry occurs from an accelerated turn with external drop tanks installed, it is different from an entry with the airplane in the clean configuration. With drop tanks, the airplane momentarily rolls into a spin in the opposite direction to the original turn. It spins one or two turns in this direction and then sharply reverses itself and spins in the original direction (direction of accelerated turn).

Recovery is accomplished as during a normal spin by applying hard opposite rudder and moving the stick forward to neutral simultaneously. Remember, the only difference between spins with and without drop tanks installed is the initial spin entry. The first turn with drop tanks on the aircraft is opposite to the original accelerated turn direction.

Factory spin tests indicate that on the average, a normal spin turn requires five seconds and the airplane loses between 1000 and 2000 feet per turn.

Once spin recovery is initiated, airplane rotation will completely stop within three-quarters of a turn and altitude loss to complete spin recovery and pull-out will be approximately 5000 feet. Therefore, it is recommended that if a spin is entered below 7000 feet terrain clearance, the pilot should bail out. ●

**To help prevent further accidents resulting from spins, the following information and recommendations are offered:**

1. **Do not trim into a turn.**

2. **If the airplane snaps out of a turn at any speed, enters a spin from a low-speed, straight-ahead stall or enters any form of a spin-type maneuver, NEUTRALIZE STICK AND APPLY OPPOSITE RUDDER SIMULTANEOUSLY.**

3. **It is of utmost importance that the stabilizer be released or the stick brought forward to approximately neutral. RECOVERIES CANNOT BE RELIABLY EFFECTED IF THE STICK IS HELD BACK. Also, because of recovery attitude, full-forward stick is not recommended.**

4. **If confused as to what recovery technique to use, release all controls.**

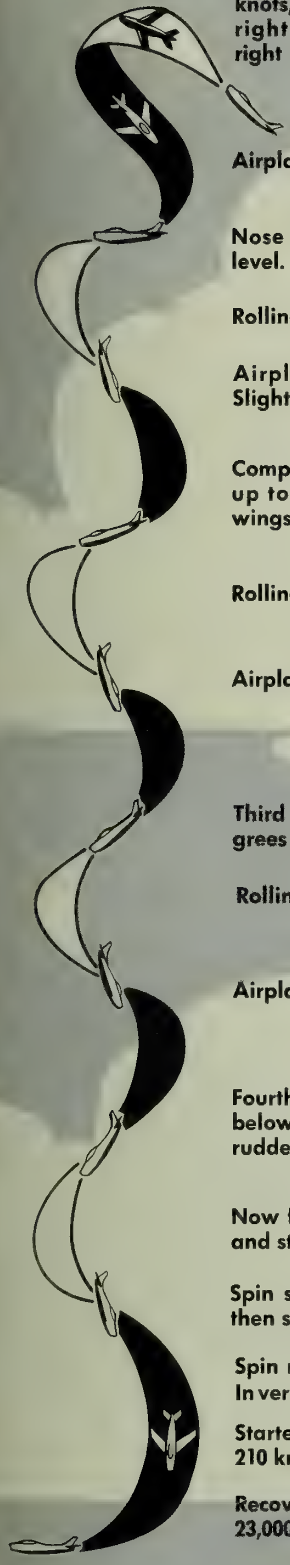
5. **A recovery characteristic of the F-86 is that THE SPIN SPEEDS UP MOMENTARILY DURING RECOVERY. Therefore, don't let this mislead you into thinking your recovery technique is ineffective.**

6. **It is considered that the spin recovery procedure in the Pilot's Handbook is the equivalent of that given in recommendation No. 2.**

7. **After rotation has stopped, BE CERTAIN you have sufficient airspeed before initiating any pull-out.**

8. **To minimize altitude loss in a spin and recovery, retard throttle to idle.**

First spin will be entered from a 1 G stall straight ahead.



Now at 35,000 feet. RPM 70%. Pulling nose up. 140 knots, buffet starts. 130 knots, airplane yawing. 120, 112 knots, 36,700 feet, fully stalled. Full right rudder, stick full back. Into right spin. Throttle retarded.

Airplane noses down to vertical.

Nose comes up to horizon, wings level.

Rolling to the right, nose drops.

Airplane noses down to vertical. Slight rudder buffet.

Complete second turn, nose comes up to 10 degrees below horizon, wings level.

Rolling to the right.

Airplane noses down to vertical.

Third turn, nose comes up to 40 degrees below horizon, wings level.

Rolling to the right.

Airplane noses down to vertical.

Fourth turn, nose about 60 degrees below horizon, wings level. Heavy rudder buffet.

Now for recovery. Hard left rudder and stick to neutral.

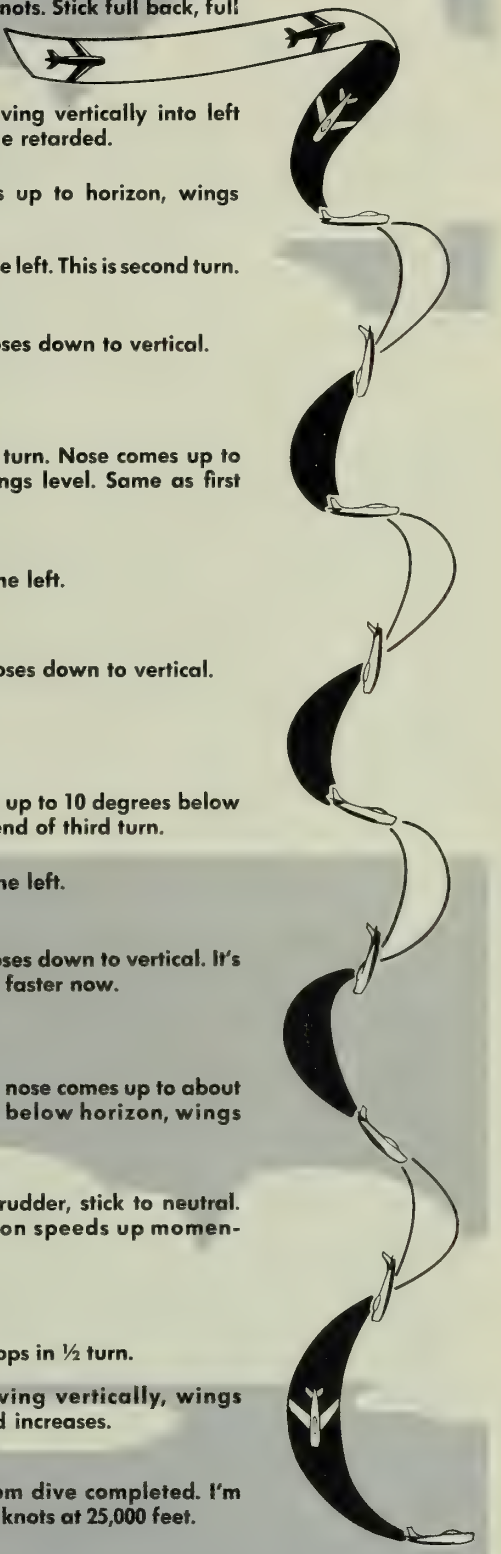
Spin speed increases momentarily, then slows.

Spin rotation stopped in ½ turn. In vertical dive. Airspeed increases.

Started 3 G pull-up at 25,000 feet. 210 knots.

Recovery complete, flying level at 23,000 feet. Everything fine.

This will be a four-turn spin to the left from a 3 G climbing turn.



Altitude 35,000 feet. Military Power and 100% rpm. Now turning to left. 2 G, now 2½ G. Heavy rudder buffet. 3 G at 150 knots. Stick full back, full left rudder.

Airplane diving vertically into left spin. Throttle retarded.

Nose comes up to horizon, wings level.

Rolling to the left. This is second turn.

Airplane noses down to vertical.

End second turn. Nose comes up to horizon, wings level. Same as first turn.

Rolling to the left.

Airplane noses down to vertical.

Nose comes up to 10 degrees below horizon at end of third turn.

Rolling to the left.

Airplane noses down to vertical. It's winding up faster now.

Fourth turn, nose comes up to about 60 degrees below horizon, wings level.

Hard right rudder, stick to neutral. Spin rotation speeds up momentarily.

Spinning stops in ½ turn.

Am now diving vertically, wings level. Speed increases.

Pull-out from dive completed. I'm level at 200 knots at 25,000 feet.

# Keep Current

NEWS AND VIEWS

**ARS Emergency Evacuation** — Recently a crew from the 55th Air Rescue Squadron made a landing on remote Fletcher's Ice Island, a few hundred miles from the North Pole. The mission was flown to evacuate an airman stricken with acute appendicitis.

Flying an SA-16 amphibian, the crew made a wheels-up snow landing using a special ski attached to the hull. The patient was loaded aboard in sub-zero weather and placed on a litter and the amphibian made a JATO takeoff guided by flare pots. During the return flight, ice packs were applied by a medical technician to keep the appendix from rupturing.

The rescue plane made a normal landing at Thule after a refueling stop at Alert, Northwest Territory, Canada. The rescue plane was piloted by Maj. Bernard Bailey and Capt. Donald Detwiler, members of the 55th Rescue Squadron. The 55th Rescue Squadron belongs to the 6th Air Rescue Group which provides emergency rescue service for installations of the Northeast Air Command.

★ ★ ★

**Letter from AACS on GCA Capability** — In order to alleviate a possible misinterpretation by pilots as to the capability of GCA radar to control aircraft below the published minimums, it is requested that the information below be disseminated to all major air commands and, in turn, to all pilots through flying safety meetings, etc., to thoroughly explain the capability of GCA to control aircraft below published minimums during an emergency and/or practice approach.

A survey conducted by the Office of The Inspector General, USAF, during August, 1953, indicates that the minimum approach altitudes, as published for GCA, had been widely misinterpreted as the maximum safe limit of the GCA capability. In most instances where the GCA minimums were, for example, three or four hundred feet, this was considered as a mandatory pull-up point even during VFR practice approaches.

The GCA equipment is designed to provide accurate data in relation to both azimuth and elevation all the way to touchdown point. The accuracy of the equipment increases progressively as the aircraft approaches the touchdown point; i.e., at a range of one mile a deviation of 25 feet from the prescribed glidepath would be detectable. A deviation of 12-15 feet would be detectable at a range of ½ mile, etc. The only reason a minimum altitude has been designated is to provide a safety margin for any human error on the part of both the pilot and the GCA operator. This minimum in no way applies to the capability of the radar unit.

Many tests have been conducted over the past few years with ground controlled approach radar utilizing various types of aircraft (including jets) in all types of weather condi-

Successful completion of flight by 55th Rescue Squad., 6th Air Res. Gp.

One of the Air Force's hottest and newest aircraft—supersonic F-100.

tions. These tests demonstrate conclusively that GCA is capable of controlling any type aircraft accurately all the way to touchdown, *dependent only* on the proficiency of the pilot flying the approach and the GCA operator interpreting the radar scope and issuing the instructions.

★ ★ ★

**D-Ring Trouble** — The Medical Safety Division, Directorate of Flight Safety Research, reports that recently there have been several instances of parachute D-rings coming out of their pockets during ejection bailouts. This resulted in difficulties in finding the D-rings to open the chutes. If the incidents had occurred at low altitudes the serious consequences are obvious.

Wright Air Development Center has made tests to determine the forces needed to withdraw the ripcord grip. Approximately 13 pounds of force 90 degrees to the long axis and 23 pounds of force applied downward or parallel to the long axis are required to pull the D-ring from a properly installed ripcord pocket.

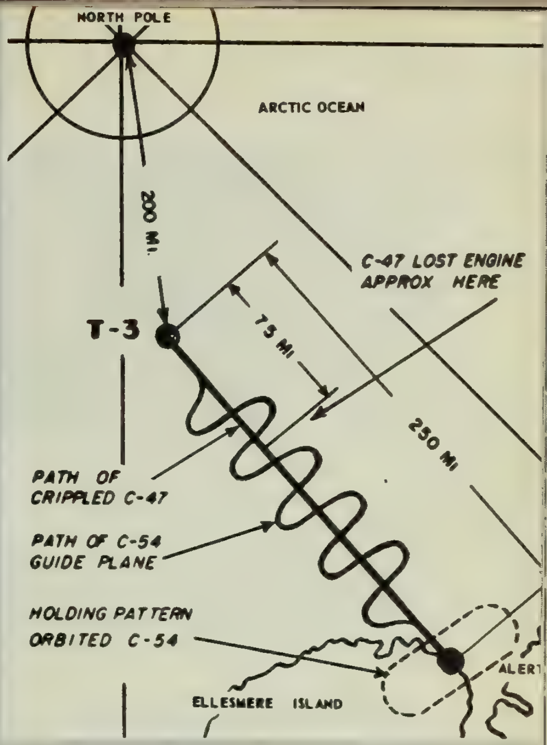
Crewmembers, parachute riggers and personal equipment technicians should be aware of T. O. 13-5-2, section II and T. O. 13-5-3, section V. These tech orders require the repair or replacement of any pocket which allows the grip to fall out, or any pocket which is so tight that withdrawal is difficult.

★ ★ ★

**Arctic Navigation Assist** — Two C-54s of the 6614th Air Transport Group on fall resupply duty teamed up recently to provide welcome aid to a Thule based C-47 which lost an engine while returning from T-3. Navigational aid and radio assistance from the two aircraft made it possible for the C-47 to get home safely under extremely adverse conditions (and we do mean adverse).

The goonie bird had been out of commission on Fletcher's Ice Island, within 200 miles of the North Pole, for 10 days. During the time the aircraft was on the island the sun went down permanently for the Arctic winter and a period of twilight set in. The lack of sun and stars over T-3 during this time made it impossible to use celestial navigation to determine the direction to Thule. And naturally, the aircraft's compasses were useless due to the proximity to the North Pole.

A plan was set up which enabled the two C-54s to give navigational and radio assistance to the C-47 after takeoff. One C-54 circled over T-3 while the other orbited over Alert on the tip of Ellsmere Island. The second C-54 was to provide an easily seen landmark in case the returning aircraft flew wide of their course.



Below is the fifth and latest of the F-86's—the H. The cannon-like object protruding from F-86H nose is an airspeed boom used only in flight test work to make exact airspeed calibrations.

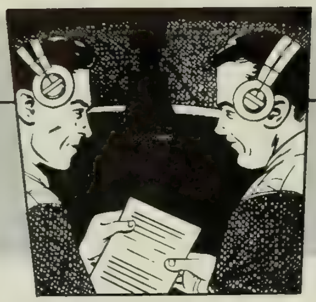
Takeoff was routine and the two planes leveled off and headed for home. However, about 75 miles out the left engine on the goonie suddenly quit. Although this was only about one-third of the way to Alert, the ice haze over T-3 made it very doubtful that a successful landing could be accomplished if the plane returned to the island. The crew elected to continue on to Alert.

Cargo and equipment were jettisoned but the C-47 lost altitude and airspeed before leveling off at 4500 feet and 90 mph. The C-54 providing navigation was unable to slow down to the C-47's airspeed without stalling. In order to keep the goonie bird on course it was necessary for the C-54 to "S" back and forth along the course in a zigzag pattern. This increased the problems of the navigator tremendously as fluctuation and error increased on his compasses.

Headwinds added to the navigation difficulties, as the two aircraft moved slowly across the frozen surface of the barren Arctic Ocean for nearly two hours. Finally, the second C-54 was sighted circling over Alert and a safe landing was made.

Despite the possibilities for navigational error and the difficulties of plotting a zigzag course by dead reckoning, the flight hit their destination right on the button.

Flying the C-54 which guided the crippled C-47 to safety were Capt. Gerald L. Martin, pilot; Capt. Charles F. Anderson, copilot, and Major Billy B. Boothe, navigator.



# CROSS FEED

## LETTERS TO THE EDITOR

### Fly Your Flight Plan

During a recent tour as airdrome officer, two incidents occurred which illustrate what I think is one of the great problems facing the USAF Flying Safety Program today: the pilot who takes a chance for no reason except that "he wants to get home."

A T-6 pilot landed here enroute to Godman Field at Fort Knox. Weather at Godman was IFR due to local rain and there were no suitable alternates within range. Finally, at approximately 1900, with weather marginal enroute, the pilot cleared VFR to Standiford Airport at Louisville. After his departure the Weather Officer told me that the pilot intended to change to an IFR flight plan to Godman after takeoff because that was closer to his home. Sure enough, an hour later Flight Service advised that he had changed to IFR to Godman. By this time, Godman was below white card minimums. Flight Service advised him to proceed to Sewart where he landed approximately three hours after takeoff. He was still a long distance from home and had tied up Flight Service for a considerable period of time, as a result of his changes in flight plan.

The other was a B-25 crew which took off at 0100 for Wright-Patterson. Weather at Wright-Patterson was 300 feet and one mile, just barely above GCA minimums. It was late at night and the pilots had been flying since early afternoon, returning home after a flight to a southwestern base. The flight was completed successfully.

Here are two cases of pilots who performed flights at night in marginal weather for no other reason than to get home, regardless of what mission symbol appeared on the Form 1.

Granted that this is an all-weather Air Force and that a certain number of flights must be undertaken in adverse weather conditions to perform essential missions or to provide needed training. It appears to me, however, that considerable progress could be made toward reducing the USAF accident rate if more pilots would place good flying practices ahead of personal desires when planning flights.

**Capt. Robt. F. Myers, USAF**
**516th TCW(M), Memphis Mnpl Arpt.**

*No comment necessary. Both pilots were wearing their lucky shoes.*

★ ★ ★

### Shoulder Harness Bracket

Here is a picture showing this bracket and its installation on an F-94B airplane. The two main purposes in the installation of this unit developed by Capt. Laurence W Lackey, a Flight Leader in the 318t Fighter Interceptor Squadron, ar *safety wise* and *tactical.*

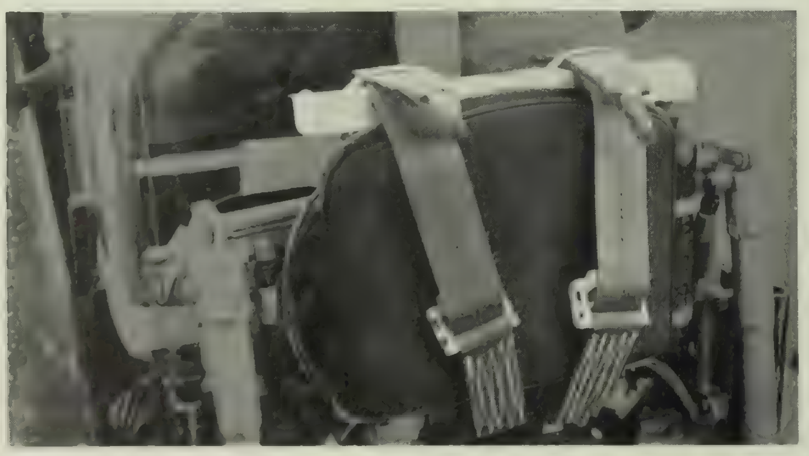
The bracket provides a place fo the shoulder harness to be stowe that keeps it out of the seat ejectio mechanism, and keeps it off the sea where it is prone to collect mud, ta etc., carried into the cockpit on th pilot's shoes. The tactical advantag is that the pilot can fasten his harnes without aid from the crew chief thereby appreciably speeding u scramble time.

This bracket has been installed o all aircraft in this organization an has met with enthusiastic approva by all pilots. The installation time i negligible and can be done durin any inspection. I feel that this uni would be practical on any of ou present fighter aircraft.

I believe that publication in you magazine would be the fastest metho of informing all interested fighter interceptor outfits of the advantages i the use of this bracket.

**Capt. Walter W. Irwin**
**FSO, 318th Ftr-Int. Sqd**
**APO 23, PM, NY, NY.**

Capt. Lackey's brain child has met with enthusiastic approval of all pilots in his unit.



★ ★ ★

### Things Equal

On page 13 of the December issu of FLYING SAFETY, the followin equation is presented in the article "Going Direct," by Capt. John C Neill:

$TC \pm W = TH \pm V = MH$

$353^\circ - 20^\circ = 333^\circ - 3^\circ = 330^\circ$

Things equal to the same thin must be equal to each other, an TC ± W is not equal to MH excep in the case where V = O and TH the becomes equal to MH.

I enjoy reading FLYING SAFET each month and think your method of presentation are excellent.

**Maj. Ralph D. McKee**
**WADC Area B, W-P AFB**

★ ★ ★

*Maj. McKee is right and we wer wrong.*

# PREPARE
# TO
# DITCH

**George A. Llano, Ph. D.**
**Tropic Section, ADTIC**
**Maxwell AFB, Alabama**

Dr. Llano's first-hand knowledge of sea survival had its beginning when as a youth he spent several years sailing along the Atlantic Coast. This experience was supplemented by military duty during WW II, field testing sea survival equipment. He has spent many days and nights in all kinds of seas, judging the qualities of life rafts and signaling devices. To test the anti-exposure suit, he cold-soaked 36 hours in the Gulf of Maine without food. While testing the distillation kit in January of 1945, Dr. Llano had an opportunity to put his sea-survival knowledge to work — he was lost from escorting craft during a squall in the Straits of Florida for two days.

**Top, one paddle supports a mast, the other is used for steering. Bottom, knowing how to use distillation kit can save your life.**

**Below, coming into shore for a landing over a reef is dangerous. At this point a man needs all his strength to combat undertow.**

EVERY airman is faced with the possibility of a forced landing. Those who make a safe descent to earth are blessed with an advantage; they may walk or they may rest. Theirs is the initiative to hold, while they make plans or await rescue.

A sea-ditching may also be successful, even if you can't walk away from it, for you can float or swim from that last bubble and eddy that marked the spot of your descent. But you will drift, never sure where you are, always wondering where you are going. You can never relax, for you will find the sea a restless, greedy element that at any time of day or night may be whipped into a fury by winds from some quarter of the sky. At first you will exist from hour to hour. Then from day to day. You are in a world which is like an inverted bowl with an ever-tilting horizon of falling and rising waters that in times of storm will appear to be forever crashing downhill to engulf you. Your life raft will be your comfort, but it will rarely take you to still waters; it will support and confine you. In storms and squalls it will come alive and turn into a shaking, slapping, sliding and always uncontrollable thing as it skids into the trough of a wave or rises to the insecure, hesitant perch of each curling crest.

Yours will be a world of monotonously hissing waters, but after a time these become as soundless as the roar of a seashell held to the ear. Your life becomes an existence between the glaring heat of sun, sky and sea and the penetrating cold of darkness. It is the nausea that leaves you weak and the hunger that parades visions of foods you never had — while you make a banquet of a bloody-feathered sea bird. It is persistent thirst, while you stare numbly over oceans of water, every drop denied you.

A castaway can never sit in comfort, and standing becomes an impossibility. Sleep is a fitful, aching sensation without rest. Emergency stores and equipment will appear meager and pitiful, but as time goes on you will hoard all, and live in a nightmare of losing them. Survival at sea is the most desolate of all emergency sensations, and yet, in spite of the loneliness and the hardships, men have endured over 100 days at sea against almost impossible odds.

This is a picture that no sensible airman would want a part in, but the record proves that airmen of the United States Air Force have repeatedly suffered the privations of castaways, and in doing so, have set a standard for endurance, courage and ingenuity in the best traditions of the sea.

### Effects of Ditching

Few can comprehend the physical and psychological effects that are a part of all air emergencies. Shock follows swiftly the realization that a landing is imperative. The order is given: "Prepare for ditching!" This is it — and you work, unconscious of your mechanical movements, to prepare yourself for the impact. For in a few hurried minutes, the airframe, engines and instruments which thousands of dollars forged into a purposeful machine to cruise the skies will become a derelict hulk. And the hours of training and experience that bind aircrews into one skilled unit will now be tested by a vast, always capricious, and at this moment a very unfriendly element, the sea.

### You're On Your Own

One long sea voyage may make a deep water sailor of a landlubber. He learns with time, and from the knowledge and actions of his more experienced mates.

An airman has no time for a shakedown cruise; he must learn fast, for his first mistake may be his last. He must readjust his thinking and living from the element of the air and speed to that of the water and waiting.

His first lesson begins when he steps off into the life raft; if the raft bobs away, he sinks into the water. One thought is uppermost — to rise and stay afloat. But he also must hold his position and then head for the tantalizing safety of the life raft. He must swim—not just struggle. He must learn to breathe properly and not to gag on the bitter salt water, to let the waves break over him and not to panic, to conserve his strength and to let the water buoy him. And above all, to act consciously and efficiently. In each movement he must hold to life. Yes, the lessons come fast, and they must be retained, for from this moment until the last hour, his ability to adjust to his circumstances will provide the only insurance that the sea honors.

### Skill vs. Chance

Luck and chance often play a role in survival, but to gamble on the chance that sometimes wins when skill and preparation seem to fail is foolhardy.

Your Mae West means life. Be sure it's ready.

The success of the United States Air Force in saving its aircrews and passengers is not a matter of haphazard opportunity. It is a remarkable coordination of intelligence, repeated training and good equipment that restores confidence and hope and provides an equity against time and the sea.

Training includes practice ditchings, preflight briefings, attention to small details, constant reminder by means of life raft and equipment exhibits and lectures on techniques. But best of all is the presence of equipment on the aircraft which serves as a continuing reminder that your Air Force takes no chances where safety is concerned.

Behind all of this stands the USAF Air Rescue Service on 24-hour alert. ARS is ready to answer all distress calls, no matter the hour or season, with patient and methodical search as long as there is any reasonable hope for survivors. Because of teamwork, training and better equipment, the present era of over-water flights will see fewer and fewer of the prolonged survival records which highlighted World War II.

### Equipment For a Purpose

The equipment that goes into your life raft was not selected haphazardly. The numerous items are the answers to the demands rising from the past experiences of the many airmen who came back to tell, complain and suggest. True, there have been improvements and refinements through Air Force research but only with one thought in mind — to improve each item for its most efficient use.

"The life raft is basic equipment and is as seaworthy a boat as was ever snapped into a small package."

The life raft is your basic item of equipment and is as seaworthy a boat as was ever snapped into a package. It is in essence an enlarged inner tube, and at first introduction, as confidence-inspiring as an old wash tub. To favor aircraft payload and range, the raft is trimmed of all excess weight, and then shaped and nudged to fit into the restricted space of fuselage or wings. Yet it functions automatically, and with an instant's tug becomes a marvelously buoyant sea craft that will weather the daily buffeting of waves or the sustained seas of a typhoon.

Water and food stores are a critical problem in all sea survivals, both are bulky and never available in desired quantity. Specialized and not always appealing candy-base foods have been provided because water is the crucial item, and when on a short or limited water supply the human body cannot easily eliminate the waste from heartier protein and fat diets. Toward the end of World War II, the research and development branches of the Air Force came up with a rather startling answer to the water problem — literally to get rid of the water stores!

In place of the heavy, bulky dozen or more tins of expendable water, two items have been substituted in life raft equipment: the Sea Water Desalting Kit and the Sea Water Distillation Kit. The former consists of six chemical briquettes. Each briquette is capable of making one pint of fresh water from an equivalent amount of salt water in about 30 minutes of kneading and shaking. Moreover, the six-briquette container takes up no more space than the old pint can!

Six to one are pretty good odds but the seawater distillation kit gives even better odds. This kit has a daily flow under best conditions of about one quart of fresh water by means of an ingenious arrangement whereby the sun furnishes the heat and the ocean provides all the water. Deflated in its container it stows into the space taken by three one-pint water cans. Inflated, it has a life expectancy that will match any period of survival.

### The Long Swim

The simple fundamentals of a successful survival are best learned in the school of experience but the factual record always leaves something to the imagination. Reading of it, one may well ask: How much of that could I have taken?

Let's take the case of a United States Navy pilot who, one sunny morning in 1942, was making life miserable for a Jap transport. He stood 5 feet, 4 inches, and in spite of his 120 pounds you will acknowledge that he was a big man. Somehow or other, this chap hasn't gotten around to writing his thriller, and for lack of a copyright title we call it "The Long Swim."

His troubles began when he was shot down and sat momentarily groggy from the impact of the ditching. Things got really rough when his radioman and he struggled on the surface minus their dinghy.

The pilot explained how they lost the life raft. "My radioman already had the life raft out and was about to inflate it, but I yelled 'Don't inflate it. The Zeros will strafe us.' Then I passed out again. As I came to, the nose of the plane was starting down. As the tail went down, it pulled the life raft with it . . ."

Buoyed up by life jackets and with shore some 25 miles away, there was no alternative but to swim.

The pilot stated, "I got the radio operator to take his shoes off, but then he pulled his pants and underwear off, too. He wasn't a good swimmer. He wanted to stop and rest and take it easy. I'd swim ahead and make him catch me."

The long afternoon dropped into night but the radioman's spirits dropped even faster so that only with coaxing, encouragement and example was the pilot able to keep the man going through part of the night. By early morning the radioman was gone.

Still game, the pilot took a fix on the nearest land, estimated his distance to be about ten miles, and began his systematic breaststroke and scissors kick against the current, waves and wind. He was determined to make it by four o'clock of that afternoon and so he rested only five minutes each hour.

When night fell, he was about six miles short of his goal. He bumped into a coconut and suddenly realized that after 30 hours he was hungry and thirsty. Here was food and drink, but with no way of piercing the husk and shell, he discarded it regretfully and began to swim again.

After being in the water this long, the pilot said: "I got so exhausted that I could only stay awake by ducking my head under the water, and then the water would get in my nose and throat and ears and I was just too damn dry and thirsty to spit it out. I felt that if I couldn't make it to the island by the second morning, I never would make it during the day under the hot sun. That made me panicky and gave me strength to swim a little harder . . . I told myself that I was a cheap specimen if I could come so close to land and couldn't get closer."

He swam all night, taking bearings on the stars. When these were blotted out, he navigated by wind direction, his teeth chattering with cold. A rain squall slashed the surface of the sea and he rested, head up and hands cupped to get some water but the accompanying wind and current carried him parallel to and past the shoreline.

Desperately he marshaled his weary body in a final attempt to hold his position, and once more passed out from exhaustion. He lay, oblivious, for about ten hours, and then awoke while dreaming of the fresh rain of the night before, only to find that he was gulping sea water without tasting the bitter flavor. His face was swollen; one eye was burned shut but he managed to keep the other pried open.

"I saw that the wind was now taking me right again, so I swam downwind, hoping that I could make land by seven that night, my third in the water.

"Early in the evening I got to the last 200 yards. I dropped my legs and saw that the water was only waist deep but had a sharp coral bottom . . . so I half swam and half walked, cutting my hands and feet . . . but I knew I was making it and was safe."

He lay still on the beach, resting ten feet from eternity, 73 hours after beginning the unequal struggle with the Pacific Ocean.

The loss of dinghy and equipment was an unfortunate occurrence, for with the dinghy the radioman's life might have been saved. The decision not to use it until all danger from strafing was past was a natural one. But the equipment should have been freed from the aircraft and kept in readiness. The life jacket saved the day for the pilot, especially since it was the type that permits sleep and rest. Without it, in the total absence of food and water and in view of his enormous effort, he would have foundered.

However, the other man also had a life jacket. But you may recall that he shed not only his shoes but his pants and underclothing. The pilot took off his shoes but kept on his clothes. He believes this gave him some protection from the cold water. The fact that the radio operator was a poor swimmer was not too serious, but he had no heart for the effort. In this respect the ensign was supreme. He showed remarkable levelheadedness and courage in his battle for survival. He took bearings with a measured eye, estimated his distances, timed his effort and above all set himself a goal. He noted the wind with care and when night hid the shoreline he went by the stars. When the stars were clouded over he swam by wind direction. He lost consciousness but never his judgment; he lay exhausted and gained a breathing spell. He ached and pained and hoped and struggled. And he made it, although he didn't have much to work with except a strong desire for life, preferably on land.

### On Again . . . Off Again

This Navy pilot's feat should make any other story anticlimactic, but the ocean is full of tricks that can try a man's soul. No one knows this as well as an Air Force lieutenant who parted company with his Mustang in June of 1945 over Jap held waters. This incident lasted only seven days and all the while the lieutenant had the feeling that it would be a short, not too rough survival experience. He was unhurt, had a good one-man raft, some chocolate rations, water and a de-salting kit and a variety of signaling equipment.

He knew he was on the route between the home base and targets, and he was determined to make his presence known to all friendly flights. So he checked the signaling equipment. He found a smoke bomb, some flares and some water dye. He knew a little dye on the surface of the water would go a long way. Anybody could spot the orange-green color. He rummaged some more and found a small package labelled ".45 tracer." Fortunately, he was lucky enough to have hung on to his .45! He felt he was prepared, with nothing left to chance. From now on he would operate strictly by the book.

Friendly aircraft flew overhead but no one saw the flares, the smoke, the sea dye color, or the .45 tracers, or heard the indignities hurled up at them.

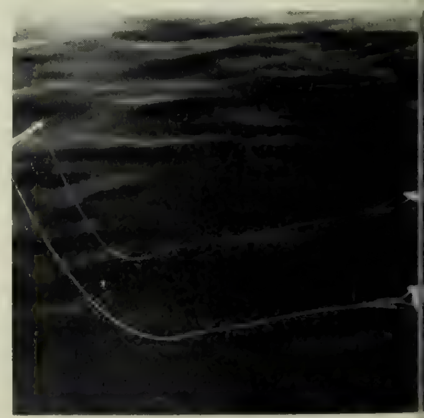
Four days passed by, marked by periodic gnawings on a chocolate bar that was finished on the fifth. Then the emergency water was used up and the pilot hauled out the de-salting kit. He had read the instructions over and over and knew just what to do. He found the plastic bag, dropped in a package of the chemical and added sea water to the filling line. Gently he kneaded the briquette to a powder. A taste proved it was still too salty. The instructions said to shake for an hour, so he kept on shaking the bag. Finally, time was up. He held the bag over his head, carefully loosened the screw plug and drank. It wasn't bad, just a little warm. So he tied the bag to the raft and let it hang overside to cool.

That night the sky was black with clouds that seemed to hang low over the long oily swell. The Lieutenant noticed the approaching storm but coiled his body within the confining bulge of his life raft, determined to sleep it out. He awoke before daylight to a wind that screamed like a banshee and flung stinging spray into his face. The waves seemed to take hold of the raft and give it a spin, sending it skidding over the water in a series of jerky pushes.

With dawn he saw in amazement the waves rising to tower over his infinitesimal craft which, for the moment, lay quietly in the shelter of a trough. Swiftly they elevated him to the crest; up and down he shot as if on a roller coaster. Five times, maybe more because he lost all count, the invisible hand of the wind flipped his life raft over, and as many times he righted it and dragged himself back into it. Doggedly, he fought the life raft, the sea and the wind.

On the seventh day the wind died down, but the sea still raged as he began weakly to take stock of his situation. He had lost all but one pint of water; that was the pint he had tied over the side of the raft to cool.

He took a drink and went to sleep,



never doubting that he would be found eventually.

He was spotted by an alert crewmember of a Navy submarine a few minutes after it had surfaced for fresh air. The sub had come up from its anchorage under the ocean where it had lain to weather the 100-knot typhoon which even at a 200-foot depth had rocked the submarine to a 10-degree roll. The crew found him babbling incoherently, his body covered with salt water sores, badly sunburned and lacerated by the life raft fabric. Yet he managed to climb aboard without help. For that reason, the crew refused to believe that the Air Force lieutenant had ridden out the storm.

This pilot had good equipment but he should have made it fast to the life raft. It was no fault of his that the signals failed to attract attention. High flying aircraft are not easily contacted with manual signals, and when their crews are intent on a mission or course, they rarely bother to scan the monotonous waste of the sea. His passive drifting and measured use of food and water helped prepare him for the ordeal of the storm he hadn't planned for; yet that was the only preparation he could have made.

He might have used his clothing more efficiently to protect himself from the sun's rays, but there was little he could have done to ease the salt water sores or lacerations from the life raft fabric. Luck and chance gave him a helping hand where sensible and methodical planning seemed to have failed. He fought to stay alive, never faltering in the hope that he would be found.

### What Would You Have Done?

Davey Jones' Locker is full of good intentions robbed from many a remorseful soul who, through inadequate planning or the confusion of the moment, failed to grasp his chance for survival.

Those who hung on and won out can tell of their experiences which, since they survived, may be accepted as the right actions. We who listen may criticize, for criticism often comes easy from a comfortable chair, but if you were to place yourself for a moment in one of these situations, what would you have done?

Let's say that your fighter quit over Cold Bay. You make a successful forced landing only a half mile from shore. The sea is calm, and with your Mae West you should have no trouble getting to the beach.

The plane sinks in 20 seconds, but before it does you tumble out, fearful of the suction that may drag you with it. The seat parachute is still fastened to your body, so naturally you float, but with your face under water and your rump high and dry. You want air, but you won't get it until you unsnap the leg harness. This is slow work, but you do it. At last you are right side up, gasping, but settling lower into the water. Haven't you forgotten something? Your life vest! Boy, jerk that $CO_2$ release!

The biggest sea weed in the world grows in Cold Bay, and you know it, for the stuff lies all around. With considerable effort you push it aside and move forward. The heavy boots feel like lead, and catch repeatedly in the sea weed.

You struggle and thrash, but you've been spotted and a rescue airplane drops a raft to you. See it? It lies a hundred yards away, a dry, saucy yellow dish that is already beginning to swing and drift with the outgoing tide. You try again, and then you feel the tug of the shoulder harness and the dragging chute you forgot to remove. You take it off and swim some more, pushing the chute before you. Why? It barely supports you. You're panting and exhausted; 20 minutes have gone by and time is running out.

In a hazy sort of way you know you want to live but at the same time you've resigned yourself to drowning. Only your subconscious calls it "resting." You feel comfortable and a little sleepy.

When you first splashed into the sea, the water was biting cold. Your stiff, numbed fingers could barely re-

Left, sea anchors help to stabilize a raft by keeping it pointed head-on into the wind.

★

Right above, knowing survival procedures saved this pilot. Chute used as anchor aid.

★

Right, below, housekeeping in a life raft is at best, crowded. If each occupant has a specific duty, he can add to good will of group.

". . . the value of good equipment and training cannot be overestimated . . . familiarize yourself with equipment—know where it is before aircraft leaves base."

Chutes open full as airborne boat nears water for a perfect drop. Correct use of signaling equipment enabled the rescue plane to spot the survivors in their small raft.

lease the leg harness straps. You felt the cold first in your hands, then gradually it spread throughout your body. After a while you didn't notice it; that was just about the time your vision became blurred. You felt weak from something else besides exhaustion. You felt like quitting but this did not disturb you greatly.

Cold water survival is a race against time, and in water below 31°F., cold water is fatal within a half hour. If you are injured your time is reduced. You can make a half mile; three quarters is a possibility, and maybe even a mile if wind, tide and current are with you, if there are no obstructions and, most important, if you are in top physical condition.

With a raft, you can last longer—over ten hours even though soaking wet, for the air temperature doesn't drain away your body heat as consistently as the cold water of the sea.

Without a lift raft and with a Mae West vest, your only protection is your wet clothes. Slight as that may appear it is a proven fact that they do help. Above all else, you must keep moving! You must struggle toward your goal to keep warm and to keep muscles limber. You've got to produce as much body heat through exercise as you lose to the ocean. With good physical condition and continuous movement, you should not die of cold as long as you are able to keep struggling. If you float passively or hang on to any floating object, your chances are almost nil, and you will go that much faster.

The sensation of coldness doesn' last long or may be entirely absent because it acts on the skin almost a a local anesthetic. When you get o the life raft you'll pain from cold, welcome pain that tells you that yo still have a fighting chance. With col there also comes a sense of panic, sensation you've experienced man times before when you dove into cold, spring-fed pool. Now it's an uncontrollable, maniacal panic that yo will not recognize or remember Within one half to three-quarters o an hour, you may experience a feeling of resignation and comparativ comfort which all the will power yo can command will not budge one iota

How can you swim without getting wet? If you can keep dry, you ma stay warm. You could rub fat over your body, but 20 seconds hardl gives you time to unzip your jacket not to mention all your other heav flying clothes.

The answer lies in the anti-exposure suit — a light, one-piece, rubberized coverall that incloses all your body but your face and hands, and seals the water off at the neck and wrists. It fits loosely over your clothing and traps the air, providing buoyancy and some insulation against the cold water. This can be worn under the Mae West, or it may with practice be donned in a few seconds short of 20—just before ditching if you don't panic. The boys who flew the Aleutians never had it — but it's ready now for all future emergencies.

### Signaling Methods

The assortment of signaling equipment that the Air Force's supply experts stuff into the glory hole of a life raft would put Noah to shame. But it is done with purpose and method, for survival often depends on how well you let others know where you are. No one knows that better than the man in the drink with only his head above water, and that showing up for that instant between troughs when a wave lifts him for one teasing glimpse of the horizon. What is the expert's answer to this dilemma?

All personnel are provided with a bright orange-colored life vest to keep afloat. Its color is distinctive, but the area exposed is so small that many a search aircrew has flown over swimming survivors without seeing them. Because color isn't enough, each life vest contains four items of personal equipment:

There is a whistle which may be

heard in calm weather by a close-passing vessel. In a good stiff breeze you may have trouble hearing it yourself.

At night you may also use the waterproof, floating flashlight which is pinned or tied to your vest. This may be seen at 100 yards under favorable night weather conditions.

Fluoroscein dye marker which is cemented in a small packet to the vest is proof that good things come in small packages. When sprinkled on the surface, the dye powder tinges the water a yellow-green and is usually visible for two hours at an approximate distance of ten miles from 10,000 feet. Its effectiveness is dependent on wise use, for you must remember two things about sea dye. First, it is expendable. Secondly, its purpose is to increase your area of visibility so that others may see you, but the length of visibility is shortened by rough weather which disperses the dye quickly and cancels all your efforts.

The dye is no good at night and is less effective to attract ships at sea than aircraft. On release, the sea marker will make a bright green splotch about 100 feet or more in diameter. It has good contrast with the sea even on dull days, and any pilot who may be attracted by an oil slick will show even greater curiosity over this color—if the survivor uses it wisely. This is no gamble, brother, but a test of your good judgment! Don't use it when you hear aircraft above a continuous cloud cover or low on the horizon.

The last item is the signaling mirror which experience has proved to be one of the most effective and most frequently used signaling devices. It is small, simple to use and will reflect sunlight for a distance of eight or ten miles. It must be focused definitely on a moving object and on a clear sunny day it will reflect the equivalent of about eight million candlepower. All fliers over land have experienced the momentary distraction that comes with the flash of light from an aluminum barn roof, a quiet pool of water or the reflection from an automobile windshield. This mirror serves to distract and attract and, in the same way, to hold the attention.

There's the story of a C-47 transport flying south over the Coral Sea at 10,000 feet with a crew of three, all engrossed with the approaching relief of the flight's end. The pilot became so annoyed at a persistent glare that picked at his face that he finally dipped left for a look of explanation. The source was small and continually winking but he could see no reason for it. He started a letdown and at about a thousand feet, all three saw the one man raft, the man and the mirror, now flashing wildly.

There was another case, that of a British pilot who dunked into the Gulf of Aden with a Mae West and a tin of iron rations, but no mirror. A teammate came flying by, minutes after he had ditched, apparently unaware of the tragedy. There were just seconds in which to act but with great presence of mind he flashed the shiny tin bottom of the ration can towards the aircraft. So lived a pilot to fight another day.

The life raft contains other signaling equipment. One is the hand smoke signal of fire-orange or other colors which will emit a dense smoke that lasts for about 18 seconds. During the day under favorable conditions this may be seen at a distance of seven to eight miles.

Flares and Very signals can be used during the day or night. The Very signals come in cartridges and must be fired from a hand projector. They are red, white or green rocket signals which rise to above 200 feet and may be seen up to one mile during daylight hours. These last from five to seven seconds and stand out at night for much greater distances. They are the traditional signal of distress at sea. In addition to these items, the life raft may have lights which are visible at night up to five miles, more fluorescein dye, a corner reflector, the Gibson Girl and the bright yellow of the raft itself.

The corner reflector is a passive signal but it assists radar equipped search planes and ships in locating life rafts at greater distances regardless of day or night and in fair or foul weather. It consists of a lightweight, umbrella-like contraption that is erected over the raft. It is a screen of metal which reflects back to the source a large portion of the radar energy that strikes it. The effective range is two to eighteen miles, and it has been picked up on ship's surface radar at five miles.

### The Glamorous Gibson Girl

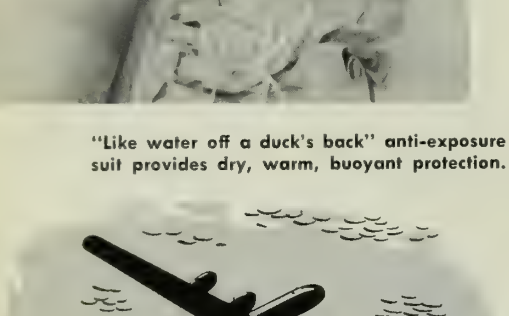
There never was a more virtuous gal in a life raft than the Gibson Girl. Her voice is legendary, yet many times she has been ignored and left to sink ignominiously with the plane. The reason is not difficult to understand, for this handcranked radio transmitter, the Gibson Girl in G. I. parlance, is never stored in the life raft. She comes in a compact bundle that has to be wrestled separately into the life raft by one man, usually the radio operator. At sea, her voice has a range of 1000 to 1500 miles, sending out an SOS that provides a fix on the location of the life raft and makes it possible for rescue craft to home on the distress signal in spite of fog or darkness. The antenna is raised by means of inflated balloons or a box kite. Once these are aloft, they also provide a visual signal which may be seen from ten miles.

There are many stories about the Gibson Girl. This one not only re-emphasizes her value but illustrates how difficult it is to spot, not one man or one life raft, but several men and life rafts on the surface of the sea.

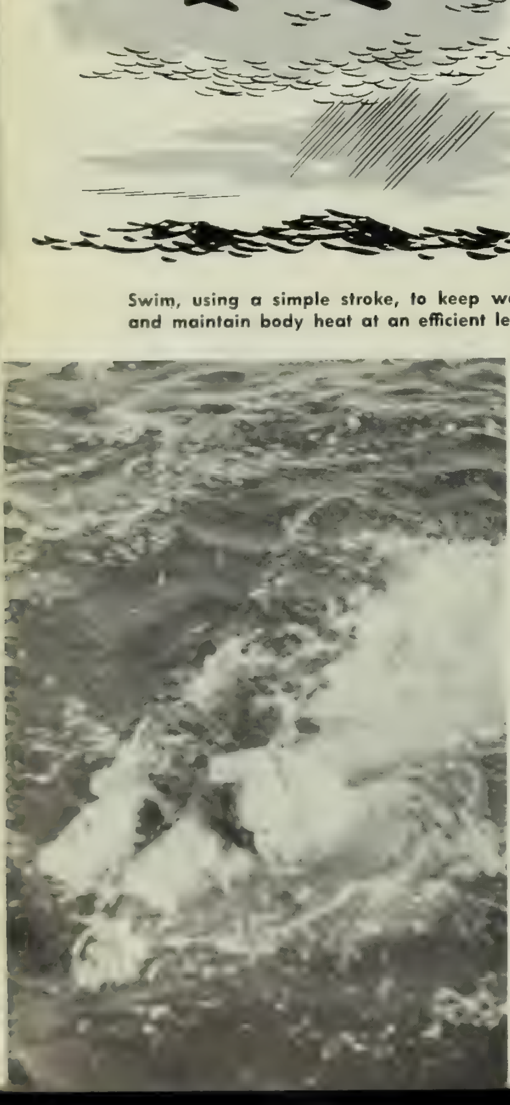
A B-29 aircraft commander who ditched in the Bay of Bengal reported, "The Gibson Girl floated near the airplane until picked up by one of the crew. When opened it was found to be perfectly dry. We sent our first message, using the box kite to lift the aerial. The wind died down so we had to reel in the antenna, dry the kite and release it again. But we found that in a strong wind the kite can be flown even if wet. Messages were sent during the three-minute period beginning at 15 minutes after the hour and also every time an aircraft was sighted. On the morning of the second day a Beaufighter homed on our set. It flew over our dinghies twice without locating us, then turned away to the northeast and disappeared. About 15 minutes later it returned with a B-29 which homed in on our set. Soon after

This rescue boat was delivered because crew member could use emergency signal mirror.

"Like water off a duck's back" anti-exposure suit provides dry, warm, buoyant protection.



Swim, using a simple stroke, to keep warm and maintain body heat at an efficient level.



this a British search ship sighted our aerial and kite, decided to investigate it and picked us up. The Gibson Girl was the main factor in the location of our crew."

### Lady Luck Shows Her Hand

With all this equipment for "hollering" at sea, it would appear that under average conditions survivors would stand a better than fair chance for recovery. Unfortunately, there are many other factors that force themselves into this picture.

Have you ever seen a sea anchor? No, we don't mean a heavy iron shank with flukes and a connecting cable. A sea anchor never holds fast. It floats high in the water or sometimes just under the surface.

A sea anchor for life rafts is relatively small, a floppy piece of cloth or rubberized fabric which can be folded much like a handkerchief. It is shaped like a bucket without a bottom or sometimes like an open, hollow cone with a short line by which it may be attached to a life raft.

This piece of sea equipment is a real hand-me-down from the old sailing days when clipper ships used them to heave-to and rest a storm out. With a sea anchor a life raft can also be stabilized in a rough sea, for by dragging through the water, it buoys down the bouncy air-filled raft and keeps it from capsizing. But supposing that you do lose your sea anchor, what then?

When you are out on a shipping search you see a lot of water, a sleepy, monotonous job. Any little change is good for a look-see and a chance for variety. This was the routine being followed by a PBM some 1800 feet above the Pacific when one of the crew noted a disturbance in the water. With the thought that it might be the plume of a submarine, the pilot dived the aircraft for the spot—and found a raft in which sprawled an unconscious man holding to a life jacket which dragged in the water and streamed a small, frothy wake.

After rescue, he told what had happened: "There were three of us in the raft. No sooner had we got aboard than because of the heavy sea and possibly the shock of our water landing, all three of us were violently seasick. *Before we recovered ourselves, the sea anchor broke away.*

"From that time on, we were a chip bobbing up and down those long green swells. From the bottom of the trough they looked two stories high. At the crest, the white water would break over us in a wall of foam. About three of those and over we went, losing most of the gear which we forgot to tie down.

"There we were, practically no survival equipment, getting tossed in the water every few hours. In 11 days the raft capsized 16 times. The sixth day was the worst. We capsized six times. After pulling himself aboard the last time, A—— died of exhaustion.

"Then the last day was bad too. B—— drowned. He just couldn't get on the raft the 16th time. That was two hours before I was picked up. If our sea anchor hadn't broken away, maybe all of us would have come through alive. Maybe . . ."

Yes, maybe . . . And but for the drag of a life jacket, and if the men who saw the wake had instead glanced away for a moment . . . ? And if the exhausted castaway had been conscious, what might he have done? Yell, pray or just wave his hands?

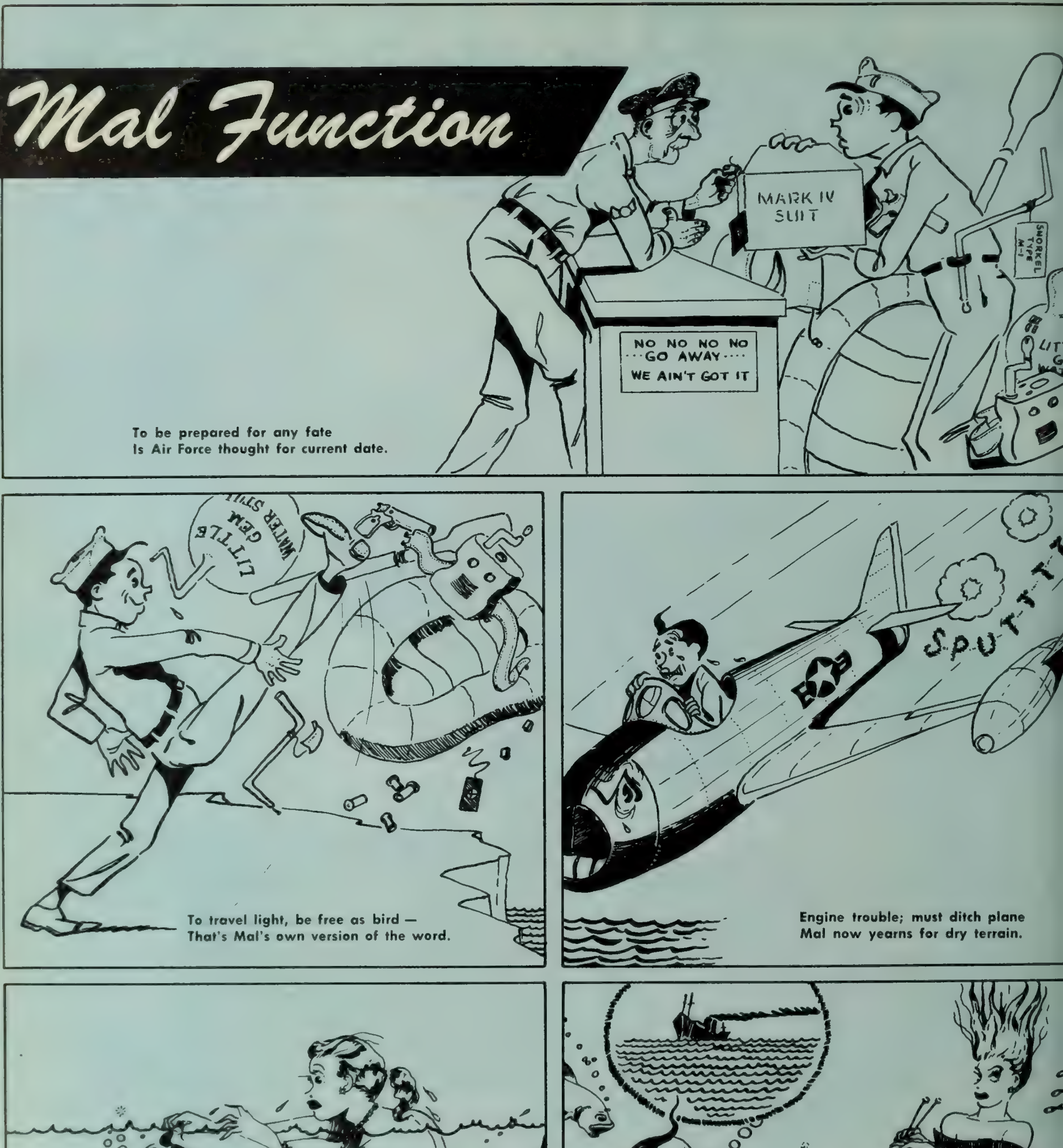
It is almost impossible to enumerate all the factors of success, the separate items or actions that have helped each man to escape the sea. One would have drowned without his Mae West; another would have perished without his warm clothing. Many lived to bless a plastic whistle, a flashlight, a tin of water, a bar of chocolate, or the Very light that wouldn't go off on the first strike. On these little things and the hope and desire for life, men have come back resolved that next time it would be different.

The incidents cited above are not hard luck stories. Those will never be written because there are no survivors. Nor are these presented with the intent to instill fear but rather to impress men with the seriousness of sea survival and to emphasize the fact that equipment isn't everything. But the value of good equipment and training cannot be overestimated, and since that equipment is provided, one should make every effort to use it. The success or failure of a sea survival begins before the aircraft leaves the home base. Familiarize yourself with your equipment, know where it is located in your aircraft and if you should ever need it, get it off! Get it all off! And hang on to it! Remember that when the aircraft commander gives the order, "Prepare for Ditching!" he doesn't guarantee you time or chance. He's warning you that in a very few seconds you may be on your own, and hoping that in a pinch you may be able to help him. ●

# You may have to SWIM for it......

Someday, somewhere, some intrepid birdman who has just been dunked in the drink may get rescued by the likes of these two fair damsels. But the smart crewmember won't count upon it. The man who knows what to do and when to do it if he goes down in the brine, will help to save himself. Know your survival procedures and equipment.

# Mal Function



To be prepared for any fate
Is Air Force thought for current date.

To travel light, be free as bird —
That's Mal's own version of the word.

Engine trouble; must ditch plane
Mal now yearns for dry terrain.

Ocean's cold, Mal moans his plight
'Til friendly mermaid comes in sight.

'Tho Mal dreams of small-size boat
Chance of rescue is most remote.

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UNITED STATES AIR FORCE

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## SUBSCRIPTIONS

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USAF PUBLICATION 62-1

*Experts Discuss*

# POWER APPROACHES

A BIT of sea-fog is drifting in, almost to the west side of the field. Alfa and Bravo flights have both peeled off into the slot. Now you've got the Cocoa lads to sweat out before the white stuff hits the area.

It's always like that. You plan the last strike with your fingers crossed. That crud off the Yellow Sea is a dead-cinch. You can *almost* set your watch by it. Two minutes, maybe three minutes late and blooie . . . you have to vector the rest down to "K-2" or "K-9" and even then it's pot-luck. Somebody is always depending on a totalizer and winding up with a dead fire-pot. It's the same old story.

"Hello Quicksand, this is Cocoa Leader. We're at 30,000 and on schedule. How does that stuff look? Over."

"Cocoa, this is Quicksand. You're cleared right on in. No reported traffic. The time is fifty-four. Weather says that you have five minutes. Can you make it? Over."

"This is Cocoa. Yeah, we'll make it but it's going to be tight. Switching to tower now. Over."

Two minutes. Then you see 'em coming on down. They're already stacked up in right echelon and everybody's pulling just a bit of power. There's not much smoke.

"Hello tower, this is Cocoa One. How's that fog look? We're about twenty north and just passing through ten thousand."

"Cocoa, this is . . . tower. I'm reading you five square. That sea fog is moving in fast but you'll make it, I think. Use zero three. Wind west, eight. Altimeter, two nine nine five. Call gear on base. Over."

"Roger tower. Runway zero three. Two nine nine five! Okay you guys. Close it up. Regular spacing. Watch my break. Play it right. That damn fog is going to hit in a minute. Speed brakes . . . NOW!"

Sweeping around in a smooth turn the flight of four fighters come whistling upwind over runway 03. This is going to be a real squeeze-play, but they're committed.

The lead plane rolls up on its left wing tip and cuts a smooth arc through the sky. You can just see some misty vapor trails. The number two man is watching and counting. Now! The second plane heels over sharply and scoots around the 180 degree turn. Number three . . . Now!

The last of the flight, number four, hesitates for a moment, then wracks into a vertical bank. If you were up there, you'd feel the shudder. Watch it lad - - - not so tight!

"Hey, Cocoa One to Four. Take it easy will you. Oh for the love of . . .! That's the umpteenth time I've warned you about dropping your gear on the break. What do you want to do . . . pop every line in the system? Okay guys, watch that spacing. Tower, this is Cocoa Leader on base, in the green, pressure up."

The four planes are spaced nicely now. Number one rolls onto final and comes smoking on in. He looks fast at first but as the nose comes up you realize he's right in the groove. The main gear touches lightly and twin puffs of smoke go drifting back from the tires. Real nice.

Number two is just back of the leader and lining up for the right side of the runway. He's rolling a bit from jet-wash, but this lad is sharp. Chalk a line across the runway and you'll find his touchdown spot directly across from the leader. This is good; real good formation.

The third ship is rolling around the final turn. It's pretty steep and you sort of hold your breath. Even empty the wing-loading is on the high side. Steady now boy, don't suck in too tight. Hey! Watch it. You realize that he's overshooting the turn and number four is right in his stove pipe.

"Tower from 893. Going around."

You see that tell-tale blob of smoke from the tail pipe and you watch and wonder if he's got enough go-juice. Patches of scud are crossing the active right now.

Then it happens. "Tower . . . 893 . . . Mayday . . . Mayday . . . flame-out . . . I'm . . ." You see a flash of silver as a wing comes up, then the plane is gone into the gray nothingness there to the west.

Mobile Control is yelling into the mike. That's bad too for he's overmodulating until things are really garbled. Number four is wracking around on his final and sucking the stick into his guts. Maybe he's punching the pilot-type panic button a bit too for you can feel that this lad is suddenly real gone.

"Hey! Loosen up that turn. Come on boy, fly it up. FLY IT UP TO THE RUNWAY. Use that throttle. Get the nose down. DOWN!

You think of others. One second the plane's staggering along, almost up to the overrun and then . . . in he goes. There's a big cloud of greasy smoke and you know the tanks have blown. This time it's different. Number 4 comes sliding up to the runway on the belly. He's swiped off the gear but the plane is not burning. Boy! That was close. Too close.

It was a successful strike. The guys went out and did a job. They did it thoroughly, too. At least the people on the receiving end felt that it was successful. So now, how does it wind up? Everything goes according to schedule. Sure, there isn't any JP to play with when the four get home, but sometimes it seems to be that way. The leader sets up a good pattern and expects his men to follow it. Then somebody fluffs. An overshot turn or a power-off approach and there's two perfectly good airplanes out of the picture permanently. The pilots? They were so lucky you'd find it hard to believe. They both made it, and, intact too.

Okay, maybe you'll say, "This is nothing but a hypothetical case. What are the *real* facts about poor patterns and power-off approaches?"

Read and heed. This is straight from you-know-where.

### Pattern Analysis:

Admittedly the foregoing case was hypothetical. Nevertheless, in the files of the Directorate of Flight Safety Research we have case after case that parallel this almost 100 percent. And in many of them, weather and low fuel aren't even a factor. Fortunately, such instances are the exception rather than the rule, but when we dig back into the history of a pilot who is unfortunate enough to clobber an airplane, we invariably find an inherent weakness that came about as a result of early carelessness which was then allowed to become a habit.

From the time a pilot starts his initial pitch-out, until the landing is safely effected, the entire pattern determines whether the maneuver will be safe and successful or dangerous and possibly unsuccessful.

We've spent a whale of a lot of time studying landing patterns in jet aircraft. We've flown our share too, both in combat and in peace time. That doesn't necessarily make us experts, but, here's what we have done. We've gone to some of the most qualified test pilots in the country. Men who fly virtually every type of jet aircraft . . . and we've talked with them at great length on safe patterns and procedures. *Flying Safety* is convinced that the lessons learned by the old timers are worth passing on to you. This stuff isn't new. It's all in your dash-ones. However, our records show that a small minority must have missed the chapter on "how to fly the airplane." Follows now, a series of discussions by experienced men who really *know* their business. If you'll take it to heart, be you a good steady pilot or a hot-rock, we think it will pay dividends...to you!

## *J. J. Quinn, Northrop Aircraft, Inc.*

I have long been an advocate of the power-on approach, especially since flying the F-89. This airplane, in particular, is fast and heavy for an interceptor; it weighs plenty and is a great big piece of equipment. In spite of its size and weight, it's a darn good flying airplane. However, what I try to pass along to every squadron is just this; learn to make all approaches the easy way.

Let's look over what I consider to be a normal pattern. You make a nice, easy break and slow the plane down to around 200 knots. Remember, you're going to do either two 90 degree turns, or one big 180. Either way you prefer is okay, but, this is important; you should plan for, and make, a definite downwind leg in order to get oriented and plan the rest of the approach.

Okay, let's say that we're down to about 200 knots in the '89 and on a definite downwind leg. Right here we dump the gear and set the speed brakes the way we want them. Of course the Scorpion is a bit different than many fighters in that we can *visually* check the position of the main gear. You can see the main wheels and then feel the nose gear when it chunks into place. On top of that we have the visual indicators for a further check, plus the hydraulic gages. When the pressure comes back up and all indications are normal, I know I've got wheels under me. That's important.

I advocate carrying 80 per cent power in the F-89 all the way round. This has the advantage of giving solid handling; it gives you the feel of your plane throughout the pattern. I realize that when I speak in the terms of 80 per cent power, this must of necessity apply to the '89 only because we've got the speed brakes, or as we call them, the decelerons, to aid us. I'll speak of that a bit later.

As you come in on final, you slow the airplane down to between 140 and 150 knots, but, you have power on all of the time. Of course you have the speed brakes out and the landing flaps down, too. With this sort of deceleron working you can establish almost any rate of descent you want. Remember, with full flaps you're getting a lot of drag but have complete control of the airplane.

If there is any question in your mind about landing you can continue the approach with flaps at 30 degrees and enough speed brakes to slow you correctly. As I've said, there are any number of combinations that you can establish. The dash-one will clarify the many situations for which you *must* plan in advance.

One point I want to make clear, however. If you'll plan your approach for about 140 knots and power at 80 per cent, you'll have almost enough push to make a go-around, and believe me, you won't have to sweat out any thrust lag if you really need additional power.

If you learn this technique of the power-on approach in the very beginning, I can't see how you'd ever lose a thing by it. Some people still talk in terms of losing an engine while in the pattern. Well, of course it *could* happen, but the chances are almost nil. If that power plant functions normally throughout a mission, and you don't manage to run yourself out of fuel, I can't believe that the engine or engines will fail just because you're over the home base. It doesn't make sense. So — depend on that available power, and use it.

Remember this too. If a pattern is learned well, it will take care of the pilot. If he gets the habit of making his pattern the easy way, and, I feel the safe way, then everything will be all right. You've got to bear in mind that some days a guy will be real sharp. On others maybe he won't be so sharp—well, if he has the habit of flying right—the easy and safe way, it won't matter too much. He'll still make it okay.

Actually there isn't much more to it. You learn to set up a good pattern. You practice until it's second nature. Then all you've got to remember is to sustain the power for the rate of descent you want. Certainly you won't be pulling enough power to fly the airplane level and you don't want complete power off. You just want an easy rate of descent once the plane is on final. I can't say definitely how many feet per minute you'll want, but you'll figure that out for yourself. You don't want the plane hanging on the ragged edge of a stall nor do you want to be pouring black smoke out all over the place. Just enough power for a really easy descent.

Test pilot J. J. Quinn states that power-on approaches are "the safe way and the easy way."

In my own flying, I keep a little power on all the way to the deck, or just before the touch-down. I pull off the power when I have it made. That, to me means when I'm over the numbers. This may be a bit too conservative for some of the younger pilots but I think it is right, and that goes for any airplane. As far as I'm concerned, power means control. As long as I've got control, I'm not going to bust up any airplane.

Previously I mentioned the deceleron system. That means merely split ailerons. These give you drag only, no lift at all. The system is controlled by a handle that operates over a full range. We call it the third throttle. You can pre-select any amount of drag for the landing approach and have any amount of speed that you want.

In summation I feel that the whole business of patterns and approaches can be boiled to just a sentence. Plan your pattern, fly the plan, use the power you need and set the bird down where you planned. It's that simple.

## *Tony Le Vier, Lockheed Aircraft Corp.*

In discussing this business of approaches and landings in an airplane, I feel that this combination is one of the most difficult things to accomplish. By that I mean, the most difficult maneuvers to accomplish consistently. From the time a man takes his first flying lesson until actual solo, approaches and landings seem to take up the major portion of instruction time.

You spend hours grinding around the circuit only to get back to that situation where a landing is inevitable. Maybe it is easy for some people. I don't know. For me it was plain hard work to learn. I had to develop judgment in speed and altitude and finally, depth perception. Sure, you learned a bit of everything else too, but mostly it was up and down, up and down. Bounce. Gun it. Take it around. Down again.

In my book a landing draws more comments from onlookers and passengers than any other maneuver you might make. You bounce a little bit and immediately get comments from every witness in the area. Make a nice smooth one; grease it in, and nobody says a word. *You* may comment about an especially smooth one, but such remarks fall on deaf ears!

I remember when I first started flying. My instructor was very fussy about approaches. When I got the airplane on a base leg things had to be *right*. I had to put it in a certain position, have a certain altitude, maintain a certain attitude, keep my power right where he wanted it and above all, fly the airplane. He wouldn't tolerate any sloppy attemps. It was darn good training too. I've never forgotten his lessons.

Of course we didn't have drag flaps and things like that in those days. The landing gear was welded down too. But those early planes were light. They'd glide a long ways and you really had to chop the power back and slow 'em down to get in. Slips and fish-tailing aided a lot too but that sort of thing was confined to the old OX-5s, Eaglerock and Waco class, certainly not F-94s.

Well, we've progressed a lot in the last 20-odd years. We've seen airplanes get faster and faster and at the same time, a whale of a lot heavier. They're certainly fast today, but the airplanes of the future, those for the Air Force and the rest of the military, will have performance bordering on the missle. Of course a true missle is a pilotless projectile but as long as we still have pilots flying airplanes, we'll continue to improve performance. Stuff in the 2000 mph class will probably show up in the not-too-distant future, and pilots will be flying them too.

In spite of this thinking, we've got to consider the fact that airplanes will still have to operate in the 150 to 200 knot category insofar as take-offs and landings are concerned. No matter how fast a plane may fly at maximum performance, we'll still have to plan to bring it down, at reasonable speeds.

We can say that 200 or so is an average figure, but that's still smoking right along. So, even at that comparative low speed, we've got to have a definite pattern and approach to insure safe operation. Okay, let's discuss those factors that make up safe operation. These will be as applicable to T-33s as stuff in the 100 series.

I believe the easiest way to define a safe approach and landing procedure is to diagram the whole thing. I've sketched out what I call the "ideal pattern." Probably there are some people who will disagree with me, but I feel this way about it. After 25 years of flying, everything from Jennies to F-94s, I still use the tried and true approach and landing technique that was taught way back when . . . and . . . I'm still here to discuss it.

Let's take a typical approach. I've been out on a mission or a training flight or maybe a shake-down. It doesn't matter. When I get home, fuel is down to critical limits. I can't fool around with more than one approach and so, I plan everything carefully *before* I drop off all of my altitude.

My system has always evolved around the theory that it's easier to put an airplane where I want it by using a modified approach, than any other. By that I mean it's a compromise between the true, power-off approach and the long drag-in with everything open but the windows.

One reason particularly governs my thinking along these lines. As speed and weight of aircraft continue this upward spiral, it will become increasingly necessary to utilize power for a safe approach. Sooner or later, power will be a *must* to complete a safe approach and landing. Therefore, while we're still on the borderline of such equipment why not learn the logical technique until it becomes second-nature? It's cheap insurance, believe me.

Now, let's take a typical pattern and landing in . . . well let's say a T-33. Maybe you're just going through school. On the other hand maybe you've got several thousand hours under your belt, but it's all conventional stuff. Whether you're a student or an old hand, you still want to learn to fly this machine right.

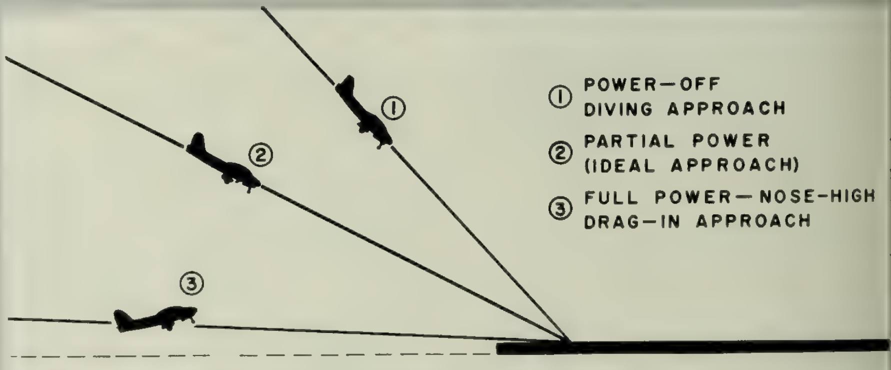
For the sake of discussion we'll assume that you have a thorough working knowledge of the airplane. The actual mechanics of flying are things already mastered and the art of a good landing is an assured fact. But, we still have one problem to overcome. How do we *consistently* bring the plane into traffic, establish a good pattern and then put the buggy on the ground *exactly* where we want to? I don't mean a good one now and again. I mean good approaches and landings all of the time.

This T-33 isn't the hottest piece of machinery going today, but it is the transition airplane you'll be exposed to for some time to come. It's clean and fast and comfortable. You won't have any trouble with this bird upstairs or downstairs either, for that matter. It gives you good control in all speed ranges and doesn't have any nasty habits.

Okay, so you're coming down for a landing. What's the first procedure? Plan your pattern, I mean *plan* it. You've got a breeze of about 15 knots on the deck and it's almost on the runway. There's no real problem here except to establish a good pattern and follow through.

On the upwind leg, over the runway, you've already lowered dive flaps and knocked the airspeed down to about 260 knots. About a third or possibly half way up the runway you roll into the break. This doesn't have to be violent. Just make a nicely coordinated turn and keep it going for 180 degrees.

If you happen to be of the "two 90 degrees turns" school that's okay too. No matter how you do it, make certain that you get the airplane on a definite downwind leg and then reduce power to about 60 per cent and get the gear and flaps down. Keep the altitude a constant factor and let the speed fall off normally. Above all, don't wrack around


① POWER—OFF DIVING APPROACH
② PARTIAL POWER (IDEAL APPROACH)
③ FULL POWER—NOSE-HIGH DRAG—IN APPROACH
①
②
③

Tony Le Vier's sketch of types of approaches. His "ideal pattern" calls for partial power.

through the early part of this maneuver like a mad-man. Sure, I know you may be hot. Possibly you even sizzle a little bit. That's swell. Save that stuff until you're upstairs. Down here in traffic, play it easy. You're not going to impress anyone with screaming tactics near the ground.

Once you're on a definite downwind and the gear and flaps have been extended keep the power at 60-70 per cent. Remember, acceleration time from 60 per cent to 100 is darned fast. Acceleration from idle to 100 per cent is damned slow. That's the most important thing to remember. Keep that mill turning in the upper speed ranges and you'll stay out of trouble.

The rest of the pattern is pretty much standard. Make a definite base leg and turn on final with ample speed. By that I mean, keep the airplane well above the stall range. That doesn't mean that you should bring the plane in like a bat out of you-know-where, but do keep a reasonable head of steam on. Fly it at 130-140, somewhere in that area. Keep enough power on to steady the airplane all the way down.

Here's something else to remember too. You who have been flying conventional aircraft are generally used to having the nose of the airplane pretty much follow the actual flight path. In the jet however, you'll find that the relation of the horizontal axis of the plane to the actual flight path is considerably in variance to that which you expect. For example, in a true power-off glide, the nose will be tucked down at an alarming angle. The rate of sink will curl your hair and you'll be quite concerned as to where to start breaking the glide for round-out.

In the full throttle type of approach, gear down, flaps down, speed brakes open and throttle at or near 100 per cent, the nose will be high. You'll feel as though you're hanging on the ragged edge of nothing. It just isn't comfortable. Bear in mind, I do not imply that this sort of approach is dangerous. I certainly do not. In fact, there may come a time when you'll *have* to drag one in, but, at the moment we're kicking around the subject of normal approaches.

Okay, now for the normal, partial-power approach. With the throttle set at between 60 and 70 per cent you'll find that the plane is extremely stable. The nose of the ship appears to be following the actual glide path and the rate of sink is minimized. Control is good and the airspeed is within tolerance. You have the feeling that you're flying the airplane correctly. Know why? Because brother, you are! That's the way the plane should be brought in. I think my diagram explains the approach clearly.

"On a landing . . . no real problem except to establish a good pattern and follow through."

Right here I'd like to inject some positive thinking about glides. Every airplane has a definite *glide factor.* By that I mean a factor that remains constant. You should take this into consideration each time you set up a pattern.

Suppose, for example, the stalling speed of your airplane is 100 mph and factory tests have established a glide factor of 1:35. Here's what you do. Multiply the stall speed by the glide factor and you come up with the ideal approach speed. In this case, it would be 100 x 1.35 or 135 mph. Then, should you lose an engine or find it necessary to make a power-off approach, you'd still have the correct speed to assure a safe round-out and touchdown.

Every pilot should be familiar with the glide factor for the particular airplane he's flying.

Now it's just a case of holding power, speed and attitude right on down to the deck. Hold it until you've got it made. I mean, hold things constant until you are assured of making the runway, then, as you start to ease back on the stick, ease back on the power. Learn to cordinate this action and you'll never go wrong.

About the only other thing I'd like to mention is the effects of wind. I don't care whether you're flying a Cub or the latest blow-torch, you've still got to consider the breeze when you're ready to set down. Of course a strong wind has compensating factors. It *automatically* stretches the runway, but, you've got to allow for it in any plane.

Let's say for example that you're coming in with a stiff breeze right on the nose. You may get the impression that the plane is stalling because you're not making normal progress in relation to the ground. The rate of sink appears to be excessive and finally you start jamming on more power. That's okay, up to a point. It's best to be a bit on the high side in a heavy wind, especially if it's gusty, but too much power can mean too much speed and then you're laying yourself wide open for a galloping or porpoising ride down the runway when you try to get stopped. So you say, "Well, what is safe then?"

Here's a good rule-of-thumb: *Take the known wind velocity and add 50 percent of that factor to your approach speed.* If the surface wind is 50 knots, add 25 knots to your approach speed. This will take care of any sudden changes, such as gusts above or below the average velocity.

Use flaps and power as needed. Stay a few jumps ahead of the airplane, and stay loose. I mean it. Make yourself be relaxed and anticipate the little buggy. After all, it's a mechanical thing at best. You are human.

That's about all I have to offer on this subject. Learn to fly your airplane right and it will take care of you. Don't ever run out of altitude and brains at the same time. Use that old throttle to get you down just the same as you use it to get upstairs. It's a two-way proposition.

***Rusty Roth, Republic Aviation Corp.***

As far as I'm concerned, good traffic patterns and power-approaches are completely synonymous. The two tie together right straight through.

There's one thing about using that engine that too many pilots overlook. I'm speaking now of present-day equipment. If that engine is going to function for an entire mission, it's going to run for the landing pattern.

Originally, when we first started flying fighters, they used to load up like mad when you closed off the power. Naturally you always assumed the worst situation when planning the approach and made a pattern that would insure getting in even if the mill quit. If it suddenly became necessary to get some power out of the engine, especially the in-lines, it was strictly nip and tuck. If the power plant was loaded up, well maybe you got some push in time, maybe not.

In any jet engine that I know of, you already have that worst condition if you pull it back to idle. It's automatic, and I don't mean it loads up either. It's just that it's going to take time to get that power back on. You've got a built-in lag, starting from idle, that can get real deadly unless you play your cards right. How do you draw a good hand? Well, let's analyze the situation:

First, we have to remember that in a jet airplane the power response of the engine at partial power is much better than with the throttle in idle. Right there is the first good card to play. Why select a power setting that automatically puts you behind the eight-ball?

Next, and this is mighty important, you're going to draw that next card on the *break*. Your speed has got to be right for the particular airplane you're flying and you've got to fly it around cleanly and smoothly. Once that break is made, you've established many things to come.

At this point I advocate pulling the power off until the horn blows. Double check this with the power setting to insure that the horn doesn't blow prematurely. You've got to kill off some speed anyway. Get that warning horn blowing while you're

rolling around from peel-off to down wind, then, as your speed falls off you can dump the gear. One advantage here is that when the racket stops you know that the gear is ready for business. Of course you check the indicators too for there's no use in getting careless at this point.

After you've checked the gear, you've got adequate time to start easing on power again. I usually use between 60 and 70 percent. The amount of power you put back on is again dependent upon the speed at which you initially broke—how far out you had to go to slow down and so forth.

Once you have the power that you feel is necessary, hold it as a constant factor and plan the rest of the pattern. Keep everything right in the groove and work your way around to final approach.

Now here's another card for that pat hand you're working up for yourself. As you come around on final, you can start to ease off slowly on the power. Normally you'll find that the power you used on downwind and base is a bit excessive for final approach, but better too much than too little. After you've got the runway lined up correctly, you'll be continually bleeding off all the way in until you finally reach the idle stop. Of course you're still carrying power down to the deck because of the inherent lag in jet engine deceleration.

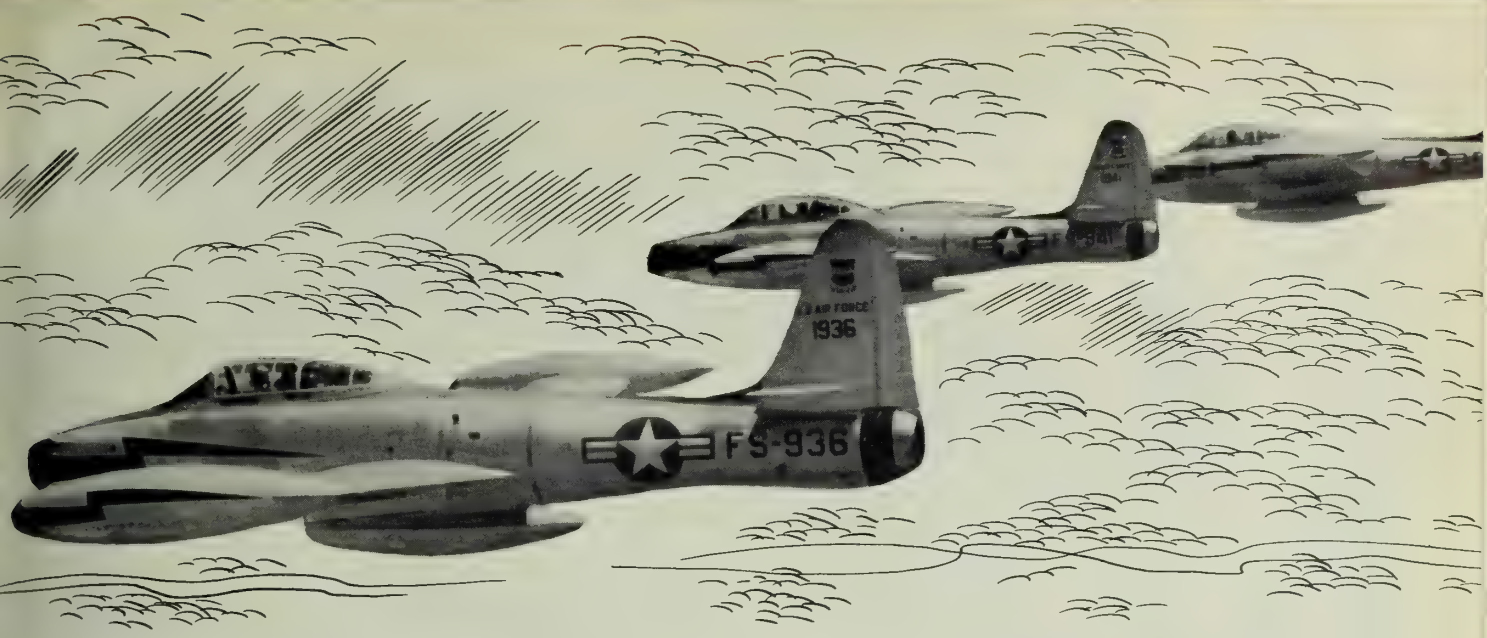
What that boils down to is this: In the same way it takes time to get thrust in a jet engine, it also requires a little time to lose that thrust once you chop it. With practice you can anticipate ahead of time and chop it a little sooner than you normally would in a conventional engine.

Now here's another card you'd better be holding. Keep this in mind and you'll be increasing your longevity by the numbers. The biggest difference between the old World War II fighters and the airplanes we're flying now is the gross weight. The old tonnage has gone up tremendously and consequently when you put the gear and flaps down and haul that power off, your rate of descent, just from gross weight alone, is almost double that which it used to be. And in order to make a round-out at a terrific rate of sink, you need a great amount of airspeed.

If you're planning to flatten out that glide on final approach, there's just two ways to do it—you can keep the airspeed well above stalling so that you make your flare short of the end of the runway and then coast up to it; or you can use a reasonable amount of power and maintain a nice shallow rate of descent and thereby eliminate that sharp corner where it's necessary to get the nose up—but fast!

Getting back to the pattern business for just a moment, I find that if I play a pattern right, again comparing it with the old propeller driven airplane, I'll dump my gear and flaps down on downwind. Then I regulate my power for desired rate of descent all the way in to the end of the runway. With a properly executed pattern I never worry about losing an engine. Incidentally, in several thousand landings with jet aircraft I've never lost an engine. In any event, if that ever happens, I know that I can suck up my flaps to compensate for the power loss and still make the grade. Safely too.

Here's one more card for that pat hand you're trying to build. Draw this one and you'll be holding a royal all the way through. Accident reports show that even on short runways where individuals set up an undershoot pattern, they sometimes hit the jackpot and overshoot.



Why? Well let's look at it this way. Take a theoretical case of a pilot attempting to crowd a modern fighter into a short strip.

He sets up a landing pattern and is trying to slap the wheels right on the end of the runway. Okay, everything is going along pretty good until he suddenly realizes that his pattern is leading to an undershoot. At this point he's in real trouble. He's waited too long to correct the situation but goes ahead and slams in full bore anyway. Unfortunately this hypothetical soul is about three steps behind the airplane and by the time he feels that he's got it made, it's too late.

He's neglected to take deceleration time into consideration and even with the throttle in idle, the old mill is still delivering push. End result? Chalk up another overshoot. In other words, you've got to lead a jet airplane all of the time. You can only get the know-how from experience. So—play it cool and get sharp.

### *George Welch, Senior Test Pilot*
### *North American Aviation Corp.*

I recommend the use of power with speed brakes extended during the landing pattern. As to the amount of power, its benefits, and the type of patterns to practice, here's how I feel about the subject.

I prefer to use about 65 per cent rpm, with speed brakes extended, during the landing pattern. This gives me good control on my speed and altitude. If I don't maintain up to about 60-70 per cent rpm, the engine acceleration times becomes noticeably poorer. For instance, the time to accelerate from near idle to 100 per cent is about 16 seconds—which is much too long for safety in the event of a go-around. However, the time from 65 to 100 per cent is about five seconds, and this seems to give adequate response when I need it.

Patterns are a little difficult to define, but I generally prefer one that is a compromise between the tight pattern and the long or very loose "gooney bird" type. This appeals to me because there is less chance of stalling out in a tight turn, and also because I don't like to be too far from the field in the pattern. However, I'd certainly recommend practicing both the tight and loose patterns since they both will be necessary under certain circumstances.

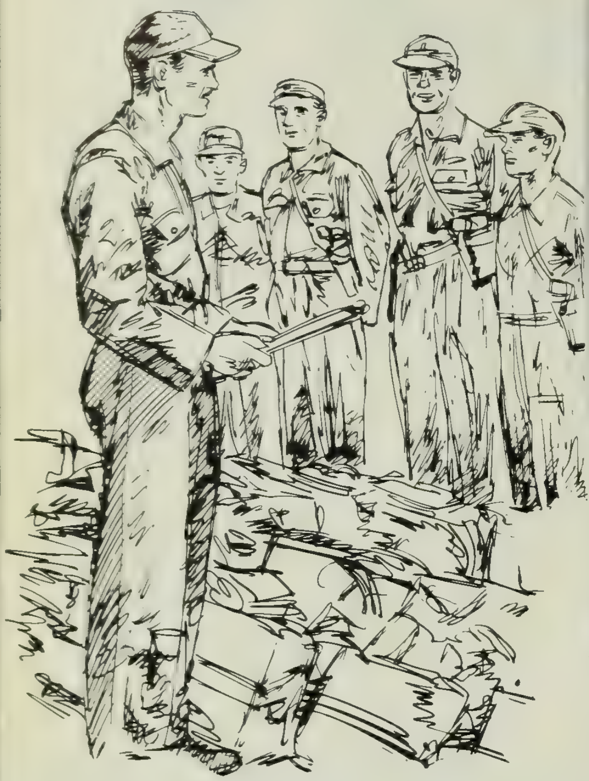
The use of power in the approach pattern is mandatory if effective wave-offs are to be accomplished. Since the engine acceleration is so long from idle, it is best to maintain reasonably high power and control airspeed by keeping gear and flaps down and controlling with the speed brakes, or attitude changes.

The approach pattern is also an important aspect in achieving a good approach and landing. If the downwind, base and approach legs are long, excess fuel will be consumed in the landing. On the other hand a tactical approach gets you on the ground rapidly and conserves fuel. However, this latter pattern calls for precision flying with little margin of error. As a consequence, routine landings should consist of a modified pattern where adequate spacing is alloted to allow for an easy approach. Keep the power up until you're close to the fence and almost ready to touchdown. If this is done you'll have it "made" every time.

It is important to practice tactical approaches so that when weather moves in or an emergency occurs, a rapid descent and landing can be made. This goes for the extended patterns that might be required at some civil or military fields.

Get to know your airplane and always keep the power up until you are certain that the landing will be accomplished safely. ●

"The crash of such an airplane is a tremendous tragedy...costs run into seven figures."



Professional skill is a must for crewmembers.

### *Your approach to flying should...*

# Be Professional

**Carl M. Christenson, Director of Safety, United Airlines**

*It was quite some time ago that Mr. C. M. Christenson, Flight Safety Engineer for United Air Lines, Inc., decided to get a lot of his safety ideas in print. FLYING SAFETY recently reviewed his article and decided that it was still very timely. As a consequence, we're reprinting it in this issue. You should give this article some serious thought. It applies to every one of us.*

★ ★ ★

LET'S take a look at flying this way. You are a businessman with a million dollars invested in a business enterprise upon which 50 to 60 employees and their families depend for their livelihood. You're in the position of finding a manager for your organization. What kind of a man are you going to look for? I am sure of one thing; you will carefully check his character, ability, integrity, and loyalty as well as his enthusiasm and personality. Why? My guess is that you want to guarantee the safety of your investment, the well being, happiness and safety of your employees and the continued satisfaction of your customers. The chances are that he will be a man who has made business management a career. In other words you are looking for a top-notch man who knows his business. Such a man is hard to find. In fact, as hard to find as a good pilot.

Men of high caliber are required to handle safely and efficiently a million dollar investment in industry because the demands of the job are exacting and tough. Likewise, the caliber of a pilot in command of a one to ten million dollar airplane must be high because the demands of his job are just as exacting and tough as the manager's job and when the chips are down, sometimes those demands are a great deal more critical than similar situations on the ground.

In military flying, as in commercial aviation, the pilot of a C-54 or a C-118 is in command of a million dollar airplane. He is directly responsible for the safety of many passengers and his crew. The crash of such an airplane is a tremendous tragedy and the dollar costs can run into seven figures.

Handling the controls is but one small part of the overall job of the pilot. The art, as such, requires an extremely high degree of skill and that skill has to be maintained through practice and training. How-

A pilot needs full knowledge of weather, atmosphere, and effects of terrain on them.

A pilot must know the fundamentals of the performance data of his aircraft. This, coupled with winds aloft information, is essential for long, over-the-water navigation.

ever, there are other "tools." They are just as important as the skill of handling the airplane. We could write a book on the details of the "tools" a good pilot should have at his command, however, the purpose of this short discussion is to consider the more important aspects of a good pilot's qualifications. In the order of value, according to our opinion, they are:

- Excellent health and psychological balance.
- A sound sense of stability and judgment.
- A basic knowledge of aerodynamics.
- A complete knowledge of weather and the atmosphere and the effects of terrain upon them.
- The fundamentals of the performance data and the characteristics of the airplane he flies.
- A basic knowledge of navigation and the facilities required to complete the kind of flying he will be called on to perform.
- A sound understanding of crew management and discipline.
- A love of flying and a real desire to make a career of the profession.

When we speak of judgment we approach a very serious, touchy and complicated subject among pilots. Nevertheless it is important because it simply means doing the right thing at the right time. The capacity for good judgment is not some mysterious thing that only a few people enjoy. It is a rather common attribute of a great many people. It can be developed or warped or destroyed. By continually keeping abreast of current developments, knowing himself and using tools available, any good pilot can stay proficient. He will develop great confidence in his ability and judgment. Through lack of fundamental knowledge and particularly through a failure to frequently exercise it, we can warp judgment into just plain stupidity.

All this adds up to making a career of flying. To do so is not as simple as a lot of people are inclined to believe. It is time and energy consuming and the demands are critical to the extreme. Each new aircraft design has made greater demands on the pilot, particularly in the field of judgment. As the size of an airplane increases, the size of the crew, the cargo or passenger load or the bomb load, as well as the technical objectives of the equipment, go up. This just means that we have a bigger job to do. The responsibility and judgment required are greater because of it.

No businessman or military commander is in a position to accept any pilot who does not measure up to the high standards required of the modern professional pilot. This modern professional pilot, if he is to be successful, must be a career man. We are not speaking here of success as being measured by simply getting an airplane off the ground and back down again, but of the pilot who, day in and day out, good weather and bad, completes his trip or mission with safety and efficiency. The pilot who successfully completes a lifetime of such flying is no "small lad," but a man who can be rightfully proud of the accomplishment.

Flying a modern airplane is a full time job. It requires the undivided attention of even the best pilot. As long as a pilot has a good healthy respect for his personal limitations and the limitations of his equipment, he will seldom get into serious trouble. But it takes a lot of tough,

"By continually keeping abreast of current developments, knowing himself and using tools available, any good pilot can stay proficient, develop confidence in ability and judgment."

hard work to elevate these limitations to a point where he can get the most out of the airplane and do it safely.

By this we mean there are a lot of pilots who can fly an airplane from one point to another and get by with it, but, in so doing, *safety* and *economy* can be seriously jeopardized if that pilot doesn't know his business. That doesn't mean that the simple act of flying isn't done properly, but to get performance, efficiency and safety out of a particular flight, it takes more than just handling the controls. It takes planning, anticipation and full command of the tools of the profession. Modern flying is big business, be it military or commercial. The professional pilot can no longer afford the luxury of not accepting the full responsibility of the job.

All of these things enter into one of the most important phases of our job . . . SAFETY! They enter flight safety because *the human element enters into every accident.* This means that the pilot, as a professional man, must take into consideration all those things that could some day be contributing factors to an accident.

In every accident there are two important factors — the machine and the man. True, there are equipment failures which will cause disaster irrespective of the qualifications of the men involved. However, in the great majority of cases, both elements are involved in varying degrees. No accident is the result of any *one single* factor. Such accidents are the results of combinations, which compound to eventually exceed the ability of the pilot and crew.

We have learned the hard way that the critical element of safety is exposure to the known contributing factors of our accident history. A constant watch must be followed religiously of all known contributing factors, and remedies applied before those factors multiply into the kind of a situation that ends in the death of a passenger or crew member. This is true for both military and commercial flying. The difference between a major and a fatal accident is more or less chance. And the margin is slim.

To achieve genuine *safety* we must have teamwork. That begins with supplying good, well maintained airplanes for the highly trained, conscientious pilot to fly. It continues only by maintaining the standards we know to be necessary. If every component part of an airplane would function all of the time, as it was designed, we would probably cut our accident rate down quite a bit. If we could maintain an airplane to absolute perfection, the rate would drop still lower. If the weather was CAVU all of the time, we could whittle it still more. And, if pilots and crew members never made a bad decision or mistake, well, then our rate would be to an almost absolute zero.

Okay, so that's an impossibility you say. Maybe you're right, but, we can keep right on trying. Remem-

"Each new aircraft design has made greater demands on the pilot, particularly in his judgment. As sizes increase...technical objectives increase."

ber, the honest and sincere endeavor on our part can never be "love's labor lost!"

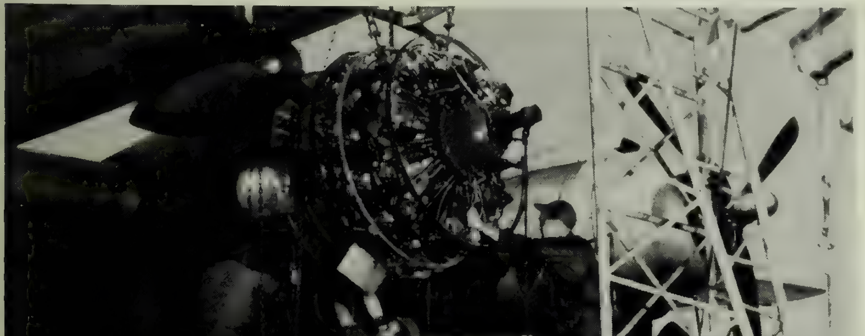
Our business requires that we translate safe thinking into action. How? First, we can ignore the problem or meet it head on. Accidents are not accidental. They happen because somewhere along the line someone has failed to do a job. Teamwork is basic and all good teams must be trained and properly managed or they break down in the clutch. It is the little things that count and no one thing is too small to ignore. All "little things" if neglected will grow into big things, and more particularly, the neglect of little things can soon create an attitude that will in time develop into sheer carelessness.

Secondly, we must train, educate and provide an incentive for all personnel. In this business of flying, a pilot, if he is to be a safe pilot, can never grow too old to learn or train. There is a great tendency to let down periodically during our career. It is a serious mistake, but it does happen.

It is in this field that demonstrated supervisory or command interest in *safety* can do the most good for both the pilot and the industry or service. The pilot who is the career man can slide with time, just as far as a commander or his supervisor will allow.

On the commercial airline it is the Flight Manager and his assistants who give periodic hood and route checks. They perform the very vital function of maintaining pilot interest and proficiency. Within the structure of the military, it is the IP and other supervisory personnel who are charged with keeping pilots at peak proficiency. Here again it is the little things that count.

"To achieve genuine safety we must have teamwork—begin with well maintained airplanes."

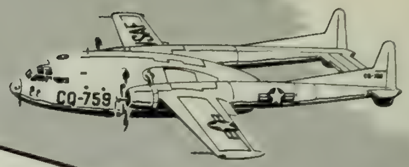


"Creeping Habit" is by far the most critical and insidious thing we have to watch. It is very easy to deviate from good, practical procedures by neglecting minor phases of procedure and thereby giving rise to the new and sometimes dangerous habits that manage to sneak up on most of us. Little deviations creep into practices without our knowing what is going on. When these minor deviations start, they must be nipped in the bud. But, nipping without explanation or logical correction can destroy confidence in any effort along this line.

Thirdly, the team as a whole must know the rules of the game. A good team or team member cannot remain good by constantly changing the rules, particularly the rules of good practice. Stable rules of the game mean continued good teamwork.

In closing let me say that as both a pilot and as a part of management, the future of aviation is probably the brightest spot in the field of transportation. Any man who chooses a career as a professional pilot has an unlimited and brilliant life ahead of him. I am proud of being a member of this great team, but more than that I find that the men and women in this business of flying are the finest group to be found anywhere.

Ours is the youngest of professions and with us rests the great responsibility of carrying human beings and cargo to all corners of the earth. And in peace and during war we carry the burden of protecting our homes and our country. ●



1C-124A-1

USAF SERIES
C-124A
AIRCRAFT

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE AND THE CHIEF OF THE BUREAU OF AERONAUTICS

There is a new look in the Flight Handbook. A redesigned cover, exactly nine sections and an appendix distinguish the new version.

# To Each His Own —

EACH flight crewmember should have a personal copy of the Flight Handbook and should take the responsibility for securing one.

The new Flight Handbook (dash one Technical Order) has many and extensive changes. A great deal of effort has been expended to provide flying personnel with the kind of operating data they want and need. A look at the factors involved should convince all crewmembers that they are missing a good bet by not getting a personal copy and making sure they get the latest revisions.

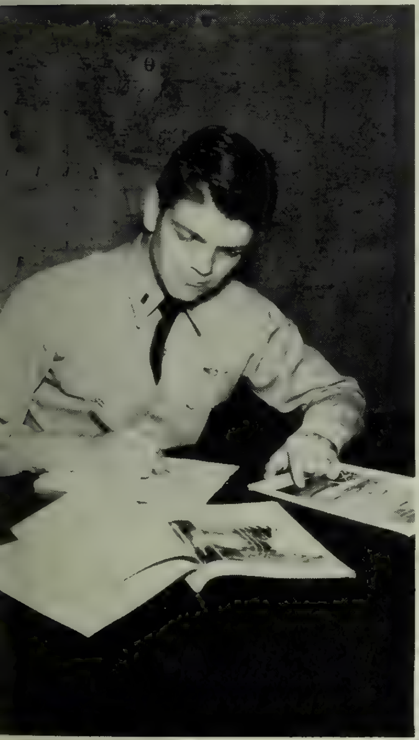
AFR 5-13 issued in August, 1953, distinctly states that personal copies are authorized for each crewmember, other than administrative. This copy may be retained by the crewmember as long as he is attached to the issuing base. However, he must turn it in upon leaving the base and draw a new one at his next base. Each base should develop a system of feeding these books to its flight crewmembers so that each will have the latest data. Some bases have found that the local Flight Standardization Board is an excellent agency for controlling the distribution. Other bases should develop whatever system is best suited to their operation.

The new Flight Handbook is easily distinguishable from the old. The new one has a full page illustration on the cover and consists of exactly nine sections and an appendix; the old had only a "spot" shot on the cover and a varying number of sections.

Preparation of the handbook is extensive and thorough. Initially, it is prepared by the aircraft manufacturer in accordance with specific requirements established by the USAF. After the aircraft is in use for a while (usually a year and never more than two) a handbook review is held. Representatives from each command using the aircraft attend this conference. Each member of the review team has two or three weeks to study and mark his draft copy of the book before the conference is held at the contractor's plant. The book is discussed page by page and the final results reflect the best opinions of the people flying the aircraft, the company that built it, the engineers who designed it and the Air Force engineers who have been assigned the responsibility of making sure every need is satisfied. The book is easy to read because it is arranged for maximum convenience of reading and locating material. Any given question can be answered by referring to one paragraph without the necessity of digging through a lengthy discussion of a whole system.

Not only is the information well arranged but it is the straight scoop. The new book concentrates on telling the user all about one specific aircraft and particularly on what makes it different from others. However, the book does not include a complete set of operating instructions for highly specialized equipment such as radar or bombsights. If it contained all that information it would be too bulky to be practical. The book contains one message — how to operate a specific aircraft. Yet, no skimping is done on the fuel system, flight characteristics, emergency procedures and other types of pertinent information in so far as they are different from other aircraft.

"A representative of each command using the aircraft has time to study and mark his draft copy before the conference."



The diagrams and text are designed so that they are understood easily by non-technical people. A full section is devoted to the limitations of the aircraft; another section covers theory of operation and peculiarities of new or unusual systems; and another is devoted entirely to the flight characteristics of the aircraft.

While using the old book, many flying personnel complained that changes or supplements were always late and sometimes not received at all. The new program seems to have this problem whipped. It provides for Safety of Flight Supplements to be issued as integral parts of the Flight Handbooks.

There are two types of supplements:

1. *Interim.* A TWX sent out within 48 hours, used only when loss of life is involved.

2. *Formal.* A distinctive sheet of paper, bearing bold, red printing indicating that the supplement concerns safety of flight. This type is used when serious damage to aircraft is involved and is issued within six working days. The formal is used also to replace the interim as soon as possible. Supplements will not be used to cover information that simply improves efficiency of operation.

These supplements have the same number as the basic handbook with the addition of a suffix letter. The suffix letters are assigned in alphabetical order from C to Z, except for I, and O. A and B are reserved for confidential and secret, respectively. If the complete alphabet is exhausted, AA, BB, CC, and so on will be used. When the flight safety data are applicable to two or more Flight Handbooks, individual Safety of Flight Supplements will be issued to each handbook.

The title page of each Flight Handbook includes a list of all outstanding and currently replaced supplements. For example, one of the books might read: "This book is not complete without Safety of Flight Supplements 01-32 BAA-1R, T and W."

Re-issues include the list in the following manner: "This publication replaces 01-27FAA-1, dated 7 February 1953 and supplements thereto: C-G and K-M. Supplements H-J remain active as well as any new ones issued subsequent to M."

Revisions state: "This publication replaces supplements 01-47CAA-1F, K-P and T. Supplements G-H, and Q-S remain active as well as any new ones issued subsequent to T." If there are no supplements, the title pages read: "This book was complete at time of issue since there were no outstanding Safety of Flight Supplements."

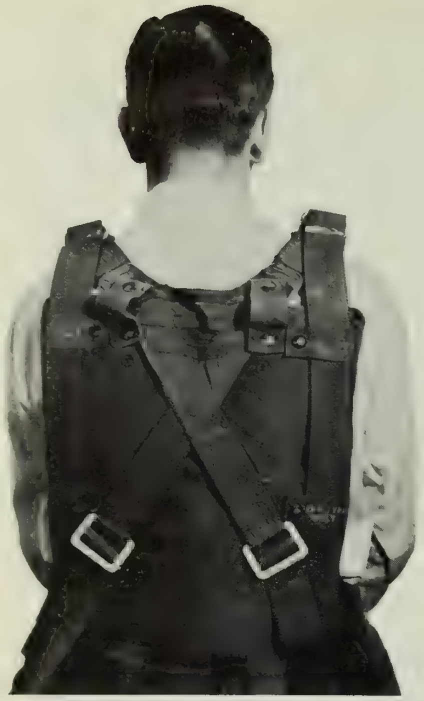
It is the responsibility of the recipient of each Flight Handbook to keep the printed list current. T. O. 00-5-1 instructs that the number of each new supplement be entered on the title page of its respective handbook as it is received.

There should be no difficulties encountered in securing the handbooks, which are distributed through the tech order system. Frequently, however, base personnel do not take the few, simple steps that are required to make this system work. T. O. 00-5-2 explains the easy means by which the automatic machinery is set in motion. Actually, all that is necessary is to reflect the required quantities on the Publications Requirement Table, T. O. 00-3-1, and all the revisions, re-issues and supplements will be forwarded automatically. It is the duty of the base supply officer to fulfill all tech order requests.

The originators of this book have tried to cover every possible consideration of the flight operating instructions problem. However, some new or special problems may arise. If so, users should call, write or visit the following address for the answer to their problem:

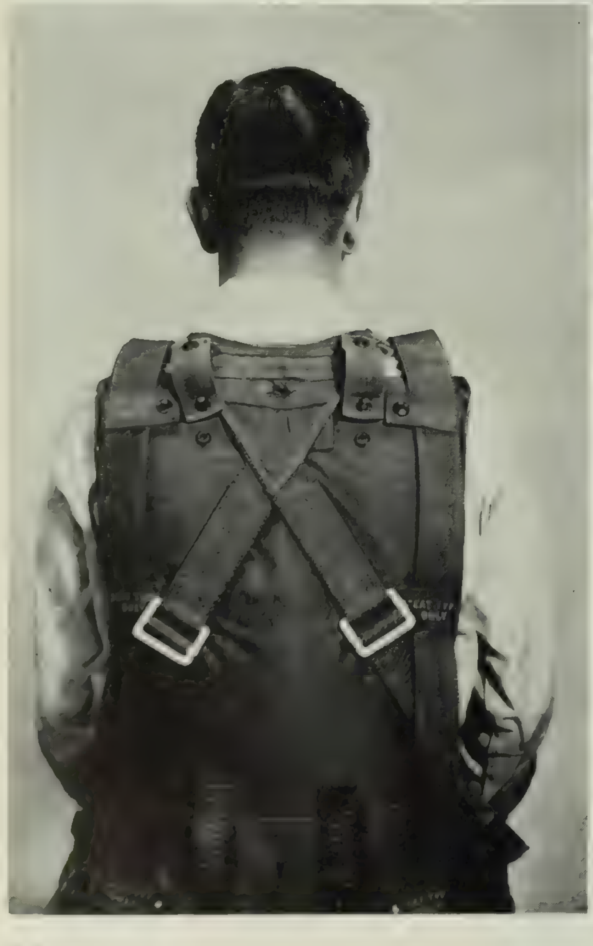
*Commander*
*Wright Air Development Center*
*ATTn: WCOSS-5*
*Wright-Patterson AFB, Ohio.*

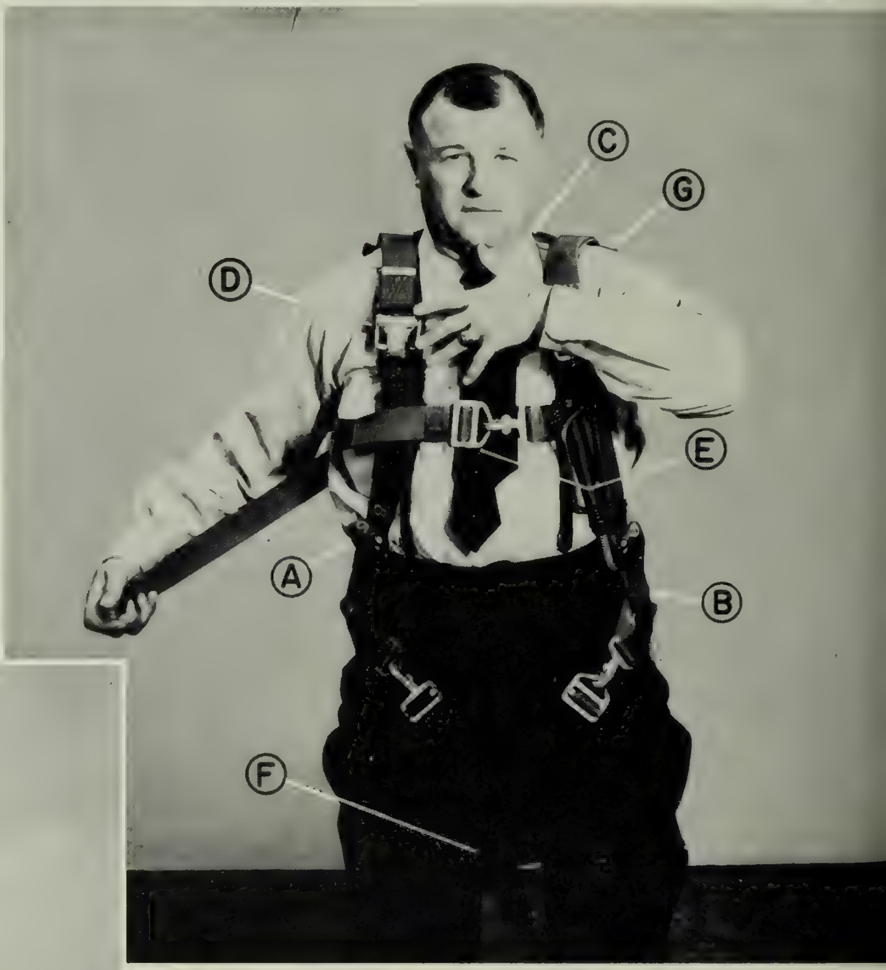
# If the CHUTE fits



Above, wrong fit. Cross straps too low on back, canopy release riding high on shoulders.

Below, right fit. Cross straps meet slightly above shoulder blades, preventing slippage.





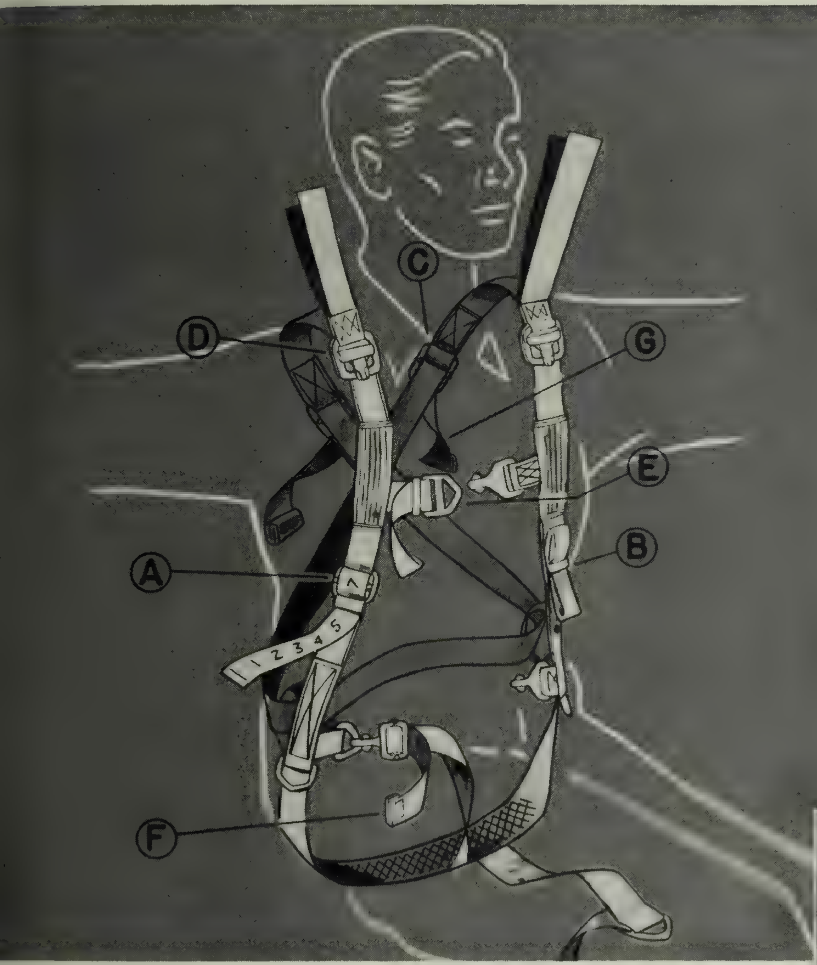
## Steps in Fitting Your Class III Harness

**A.** Prefit your harness to your sling length by setting to proper number.
Set the index number by turning the quick-fit adapter on the sling 90 degrees to the webbing and pull until your number shows.

| Height | Index Number |
|---|---|
| Up to 5′ 6″ | 7 |
| 5′ 6″ to 6′ 0″ | 6 |
| Over 6′ 0″ | 5 |

**B.** Tuck excess webbing into elastic keepers. Loosen back straps to insure that you will be able to get sling under buttocks.

**It is possible to fall out of a Class III harness during bailout if it is not fitted properly. Adjustments for individual fit are made easily. Always play it safe and be sure that your parachute fits you.**



**C.** Put the harness on. Fasten the chest and leg straps. Tighten the leg straps in back.

**D.** Canopy release should be below collarbone. If it is any place else, your harness is not adjusted properly. Loosen back strap again. Reset index number and retighten back strap.

**E.** Slide chest strap up or down the sling to the proper distance below your chin. (12″ below chin.)

**F.** Tighten leg straps by pulling down on loose ends.

**G.** Adjust and tighten chest straps.

- After fitting, loosen leg and chest straps by merely turning the quick-fit hardware 90° and pulling gently, making yourself comfortable. Tightening again requires only a few seconds.
- The Class III harness will fit men 5′ 2″ and 110 pounds to men 6′ 4″ and 240 pounds wearing heavy Arctic clothing.

"I FOLLOWED the ejection procedures and everything went as I expected with the exception of the harness of my parachute. First, I jettisoned the canopy; then I lifted the arm rests and pulled the trigger without hesitation. After kicking clear of the seat I was falling toward the ground upside down and head first. This was my position when I pulled the ripcord. I lost my left shoulder strap and only retained the right one because I had held it with my left hand in anticipation of the opening shock.

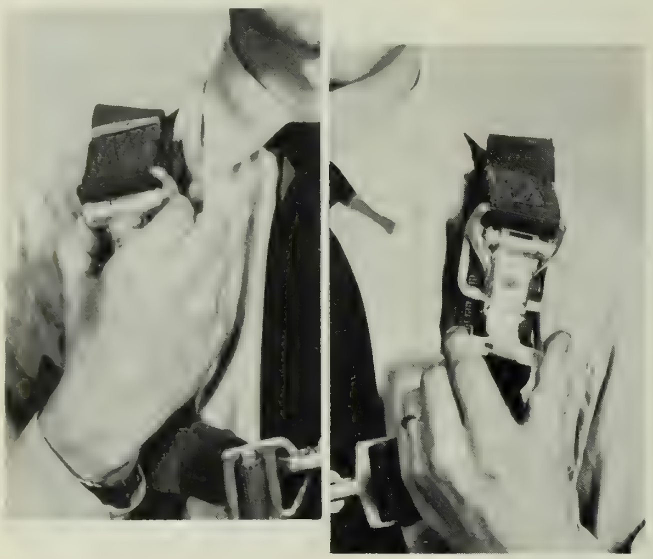
"I feel that pilots should be better informed on *proper* fit of the chute . . ."

The above statement was made by a pilot who knows how important the parachute—its proper fit and use—can be. This particular pilot was lucky. Others have not been so lucky because they did not pay attention to the details of fitting the harness.

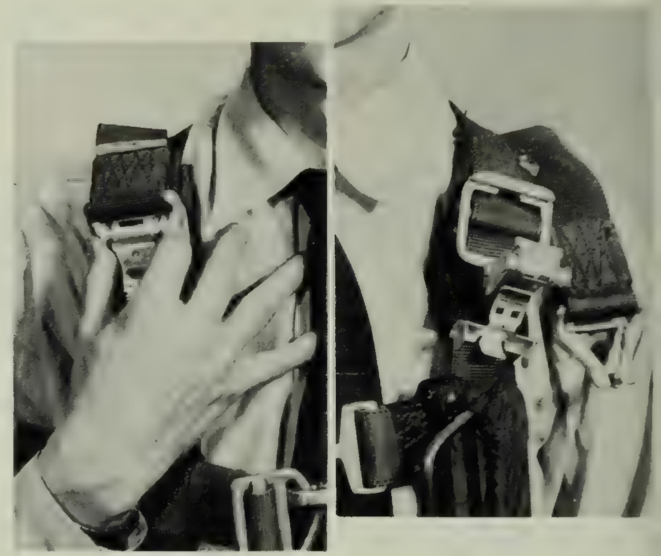
There have been cases of pilots falling out of their chutes during a bailout. This sort of mishap is not restricted to jet pilots. In other words it is not necessarily the violence of the opening shock alone that causes such accidents but rather the fit of the chute.

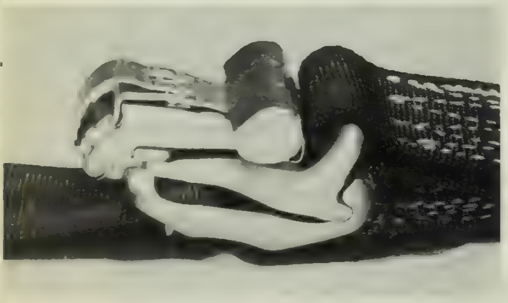
**Below, note harness modified in accordance with the tech order. A piece of triangular, reinforced cloth helps hold straps in position.**

Shown below, the first two steps in operating the canopy release. Clasp the safety clip between the thumb and index finger, pull out, down.

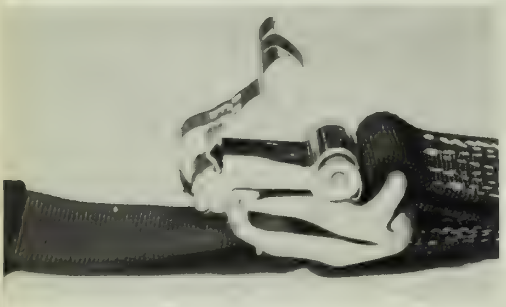


Next, squeeze both buttons and rotate the latch arm out and down. This releases canopy while retaining harness and attached equipment.

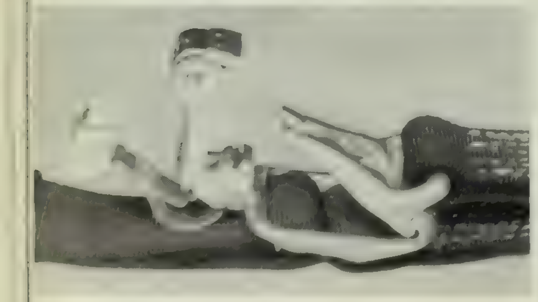




Above, canopy release is closed, safetied. Below, closed canopy release is unsafetied.



Below, opened canopy release. As hardware disconnects, canopy comes free from harness.



The pilots encountering this difficulty were wearing the Class III harness. The adjustment of the Class III as quoted in T. O. 13-5-1 is not difficult. In fact anyone can adjust any USAF harness if he knows its design features. Proper fit, however, depends on knowing how a harness should look and feel, as well as how it adjusts.

All USAF parachute harnesses are built much the same way. Each starts as a loop of webbing called the sling, both ends of which are attached to the parachute suspension lines. The sling is designed to take the greater part of opening shock.

If the position of the body during bailout could always be controlled, nothing but the sling would be needed for a safe jump. However, the sling will not stay on by itself and other straps are needed for the harness. The only purpose of these straps is to keep the user from falling out of the harness. To accomplish this, the straps must be adjusted.

The Class III harness is designed to be put on quickly, and adjusted solely by the wearer. Webbing, though 20 per cent stronger, has been reduced in weight for more comfort, and the hardware has been redesigned for minimum size. In addition, the harness is equipped with canopy releases. The canopy may be released without losing the harness or any emergency equipment attached to it.

This canopy release replaces the shoulder adapters on the older harnesses, and thus connects the canopy and risers to the harness. The purpose of the canopy release is the same as that of the older quick-release box—to prevent high winds from dragging its user on land or in water.

The release should be in a locked and safetied position when the harness is drawn for use. To inspect the releases, make sure the safety clips are snapped closed and check for possible mechanical damage to the safety clips or release arms from careless handling. The releases should never be actuated until the ground is reached. Then, if the user is being dragged, he can release the canopy. For water jumps, the user should place his hands on the safety clip about 1000 feet above the surface. The release must not be activated until the feet contact the water.

T. O. 20B-5A-21 provides the user of the Class III harness with some additional insurance. This T. O. provides for modification of the harness to help prevent slippage of the straps from the shoulders. It calls for a triangular fabric section to be installed on the diagonal back straps of the harness. However, this modification does not replace the necessity for getting a good fit and adjustment of the harness.

This harness is made for comfort and safety, but it is up to the individual user to make sure that he gets the maximum benefits of all the safety features. ●

# the ERRING EAR

**By CWO John P. Drummond, Hq. AACS**

PILOTS frequently complain that the widths of the courses of one range are too great, while those of another are too narrow. Neither has a *true* or measurable course width.

The so-called "on course" is truly a point along a line in space. As you are aware, a line has no width. The apparent three degrees course width is the result of aural phenomena and the inability of the pilot to hold his aircraft perfectly stable in space with the result that an average deviation of one and one-half degrees, plus or minus, is required before the pilot notes a change.

Low frequency radio ranges commonly are thought to produce legs or beams, having an angular width of three degrees. That is a fallacy. The "on course" signals are found at points in space where signals of equal strength are received from separate transmitting antennas at the range station. These "on course" signals may be proved graphically to be along lines tangent to fields of radiation from those antennas. The true "on course" does not have a measurable width.

The apparent three degrees course width is created primarily by the human ear. The ear detects changes in sound levels at a logarithmic rate. Thus, a fairly large change in the sound level is required before the change is detected by the ear. It has been established that the smallest sound-level change noticeable by the average human ear is one decibel. That means that the power level of the audio signal must be increased by a ratio of 1:25 before the average ear can detect any change.

The ear creates the so-called three degrees width of "on course" signals of radio ranges because of its insensitivity to the small changes in the sound level of those signals when the aircraft drifts back and forth across the true "on course." This phenomena is proved quickly by connecting an audio output meter, having an undamped movement, to the receiver and noting that the meter registers sound level changes although the ear still indicates to the pilot that he is "on course."

When the range legs are so adjusted that there is a 90-degree separation between all adjacent legs, the "on course" appears to be broadly defined. However, when the angular spacing between adjacent legs is reduced to less than 90°, the apparent "on course" becomes sharper and more care is required to hold the aircraft "on the beam." The reason for the latter condition is that the sound level changes at a more rapid rate for a given angular displacement of the aircraft.

The "on course" signal of an Adcock or SRA type range is produced by the heterodyning, or aural beating, of two radio transmitters having a frequency difference of 1020 cycles per second. (This heterodyne is similar to the "whistling" that sometimes can be heard when one broadcast station interferes with another.)

One of the range transmitters is continuously energizing an antenna that radiates a non-directional pattern. The output of the second transmitter is alternately keyed or transferred from one set of towers to a similar set. At a given moment in time, this second transmitter radiates a bi-directional signal. The direction of this radiation is alternately switched by a mechanism which transfers its power to the other set of towers. The "on course" appears at points in space along lines tangent to the fields of radiation of these alternate sets of towers. Thus, when the pilot hears the "on course," he actually is hearing the audio product of two heterodyning transmitters, and the antenna system of one *is being rapidly alternated.*

This antenna switching creates a little known kink that may be used to advantage by the pilot. The output of the range transmitter (as distinguished from the "broadcast" or non-directional transmitter) physically is disconnected from both sets of towers during the switching interval. Thus, for a fraction of a second, there is actually no heterodyne or audio signal from the receiver.

If an aircraft is precisely centered "on the beam" a weakly discernible "plucking" sound can be heard. This sound is caused by the antenna switching during the formation of the code characters for the "A" and "N."

The "on course" is, of course, the point in space where the "A" and "N" signal strengths are identical and the characters thus blend into an apparently steady tone. It is not a steady tone. There are brief interruptions in that tone because of the antenna switching. This "plucking" may be found only dead-center in the "on course" since any movement of the aircraft towards either the "A" or "N" quadrant immediately causes an increase in the sound level of the signal in that quadrant. This increased signal level masks the diminishing level of the adjacent quadrant; thus the other signal starts to fade out.

A pilot can split the "beam" by flying his aircraft so that he constantly hears the faint plucking of the code letter "X" which is formed by the blending of the "A" and "N" characters in the true center of the apparent "on course." This sound appears there, and *only* there.

The ease with which this "plucking" may be detected depends upon the mechanic at the range station. The antenna switching is accomplished by a mechanical device called the link circuit relay. This same relay produces key clicks when its contacts are dirty or pitted and thus produce small arcs as the relay transfers the output of the transmitter from one set of towers to the other. The spacing between those contacts, however, governs the period of time and audibility, when neither set of towers is energized and thus no beat occurs between the two transmitters and the 1020 cps tone is not heard by the pilot. If the relay contact spacing is increased, the no signal period is increased and vice versa.

So remember, for accurate beam flying, a pilot must stick as closely as possible to "a line in space." ●

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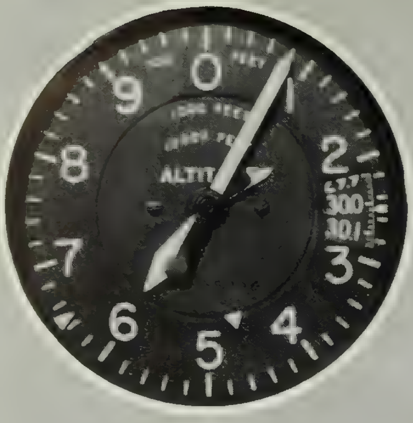

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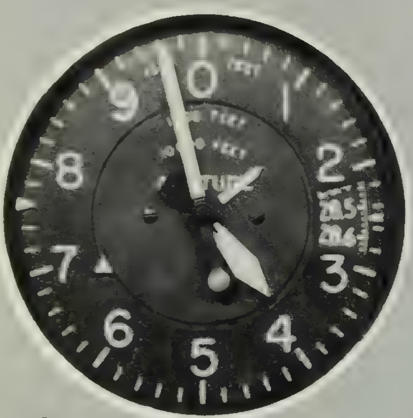

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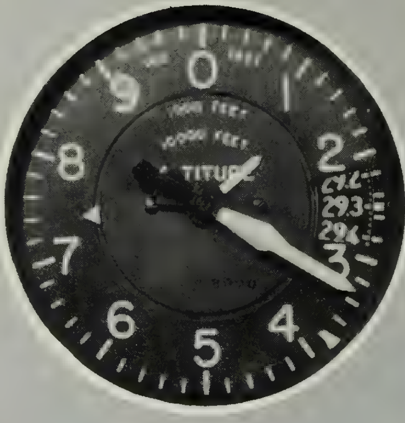

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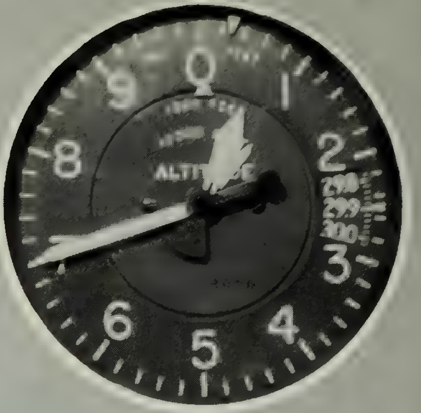

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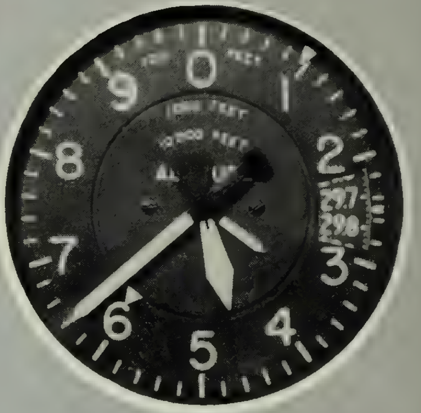


# READ IT and KNOW!

*Reading an altimeter ought to be as easy as telling time, but is it? Studies by the Aero Medical Laboratory show that at certain settings, the three-pointer altimeter is particularly susceptible to readings of 1000-10,000 feet too high.*

*This is most likely to occur when the sensitive pointer is approaching zero on the scale. If a pilot misreads his altimeter by a wide margin the results are obvious. And recent accidents prove how easy it is to do just that. Don't be a statistic. Be sure you know how to read your altimeter correctly.*

★ ★ ★

ALL too often, the altimeter is the neglected step-child in an instrument panel. Too many pilots give it a cursory glance in their panel cross-check and then don't bother to be sure they read it correctly. The dangers of misreading the altimeter came out clearly in a series of studies by the USAF Aero Medical Laboratory at Wright-Patterson Air Force Base.

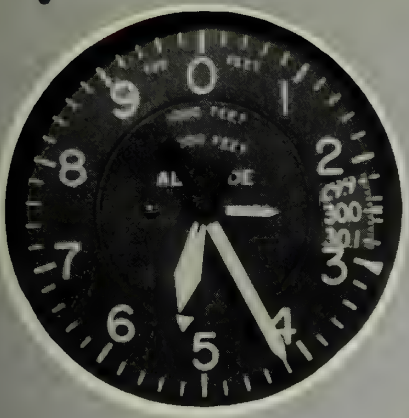
Two investigators, Fitts and Jones, asked several hundred pilots to tell about accidents or near accidents resulting from misreading the instruments. From these verbatim pilots' reports many helpful leads were obtained as to how aircraft instruments can be improved. One of the most surprising and significant findings, in adding up the results, was the number of pilots who reported difficulties in reading the altimeter. In fact, more pilots reported difficulty in reading the altimeter than any other instrument.

The following pilots' reports are typical:

"It was an extremely dark night. My copilot was at the controls. I gave him instructions to take the plane, a B-25, into the traffic pattern and land. He began letting down from an altitude of 4,000 feet. At 1,000 feet above the ground, I expected him to level off. Instead, he kept right on letting down until I finally had to take over. His trouble was that he had misread the altimeter by 1,000 feet. This incident might seem extremely stupid, but it was not the first time that I have seen it happen. More than one pilot isn't around today because he read his altimeter wrong while letting down on a dark night."

"A pilot of my bomber group was making practice night landings in a

6



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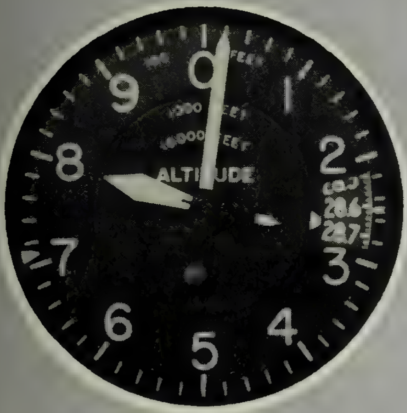

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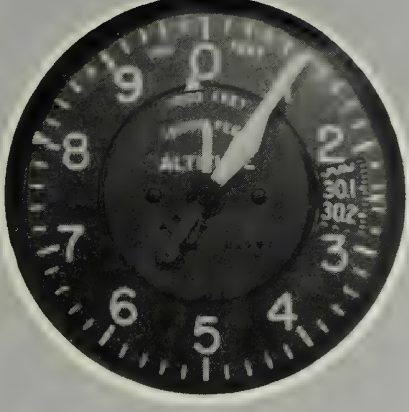

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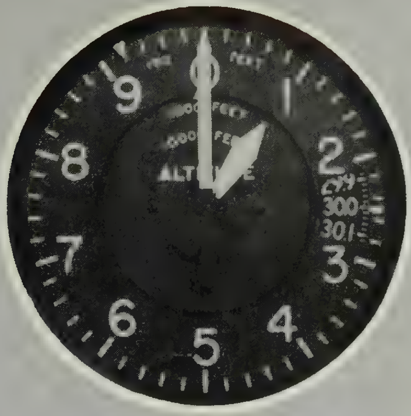

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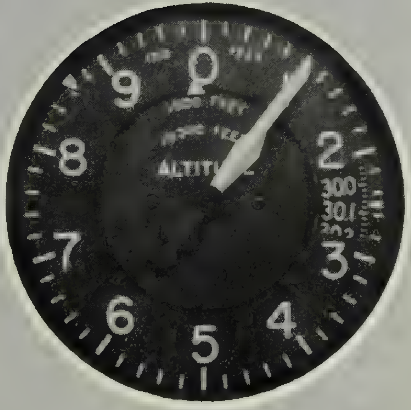


**This is a reprint of an article that deals with a vital subject. The altimeter can be misread! Try the test on these pages and then compare your answers with those on following page.**

B-29. The traffic pattern was to be 2500 feet. The field elevation was 1000 feet. The pilot misread the altimeter and was actually 1000 feet lower on his traffic pattern than he thought he was. He went through his landing procedure, had his wheels down, flaps 30 degrees and was on his final approach. Before he realized what had happened, he flew into the ground about one and one-half miles short of the runway. Luckily he hit in an open field, bounced and managed to maintain flying speed. The main gear withstood the impact but the nosewheel was ruined. By expert piloting, he made a safe landing and averted what could easily have been a disaster."

It will be noted that in both cases the pilot was exactly 1000 feet lower than he thought. In other words, he read the altimeter 1000 feet too high. In this study all the pilots lived to tell about their errors, but in how many similar cases were the pilots less fortunate? Flight plans call for 1000-foot clearance over the highest terrain en route (2000 feet over mountainous areas). Under the stress of rough air and instrument conditions the pilot may read the altimeter 1000 feet too high and reduce his terrain clearance to zero.

The 2000-foot clearance assumed on IFR flights over mountains could be lost by a combination of misreading the altimeter 1000 feet and by wrong altimeter settings or effect of orographic lifting on the density of the air.

If more of the facts were known, we would probably find that many of the mysterious collisions with mountain peaks, or landings short of the runway, were caused by altimeter reading errors. The Air Force has had no monopoly on this type of accident, and a number of airline crashes similarly cast suspicion on the altimeter.

Several years ago an airline DC-4 crashed into a mountain while letting down on an ATC approved altitude change. The flight had been cleared by Airway Traffic Control for descent from 7000 to 2500 feet, and was to report leaving each 1000-foot altitude level. Approximately three minutes after reporting leaving the 3000-foot level, with no report of having left the 2000-foot level, the aircraft struck the mountain ridge at 1425 feet. In all probability the pilot, who was thoroughly familiar with the route, had mistaken his altitude when he reported leaving the 3000-foot level.

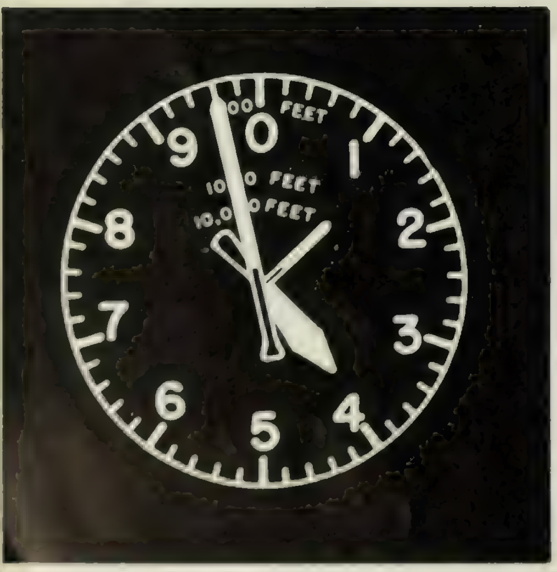
Shortly after this, a commercial C-46 crashed on a western mountain, at an elevation of 1890 feet, while making an instrument approach to Lockheed Airport at Burbank. The CAA Instrument Approach procedure called for an altitude of almost exactly 1000 feet higher at this stage of the approach, and the pilot was well acquainted with the approach procedure. A 1000-foot error in reading the altimeter provides the most plausible explanation of why the pilot descended below the authorized altitude.

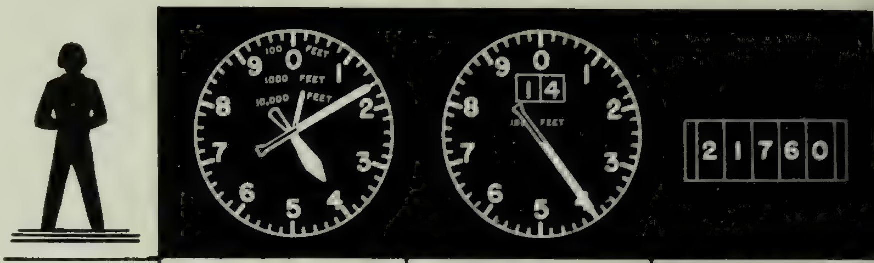
A follow-up study at the Aero Med Lab by the author cast further light on pilots' difficulties in reading the altimeter. Nine experimental instruments, suitable for presenting altitude, were tested. Included was the present three-pointer altimeter. Results for 97 USAF pilots on three of the more interesting instruments are shown in Fig 1. It will be noted that for the conventional three-pointer altimeter 11.7 per cent of all readings were in error by 1000 feet or more.

A further analysis of the data showed that at certain settings, the three-pointer altimeter is particularly susceptible to reading 1000 feet too high. This is most likely to occur when the sensitive pointer is approaching zero on the scale, as shown in Fig 2. On the particular setting shown, 11 out of the 97 pilots erroneously read the setting as 14,960 feet.

Why are these 1000-foot errors made?

Fig. 2. Eleven of 97 pilots read this wrong.





| | | |
|---|---|---|
| 15.9% of the 1164 readings by 97 pilots were wrong. | 3.5% of the 1164 readings by 97 pilots were wrong. | 0.6% of the 1164 readings by 97 pilots were wrong. |
| 13.1% of the 1164 readings were 100 ft. or more off from the true settings. | 0.9% of the 1164 readings were 100 ft. or more off from the true settings. | 0.6% of the 1164 readings were 100 ft. or more off from the true settings. |
| 11.7% of the 1164 readings were 1000 ft. or more off from true settings. | 0.7% of the 1164 readings were 1000 ft. or more off from the true settings. | 0.4% of the 1164 readings were 1000 ft. or more off from the true settings. |
| Average interpretation time was 7.1 seconds per reading. | Average interpretation time was 1.7 seconds per reading. | Average interpretation time was a fraction of a second. |

At 20,000 feet, with a 5200 fpm rate of descent at 350 mph, a pilot will lose 600 feet of altitude and cover over a half mile laterally while reading his altimeter in 7.1 seconds.

Fig. 1. The results of 97 USAF pilots making 12 readings on each instrument are shown above.

In the first place, the sensitive 100 foot pointer makes one revolution for every 1000-foot change in altitude. Therefore, if only the 1000-foot pointer is read carefully, the reading is likely to be off by some multiple of 1000 feet.

The second source of error is illustrated in Fig 2. The 1000-foot pointer is pointing to the 4 on the scale, but to read the setting correctly, it must be read as 3 or 3000 feet. The error comes from reading the 1000-foot pointer to the nearest number, when it should be read to the next lower number.

This apparently is the most hazardous type of error that pilots make in flight, particularly while letting down under instrument conditions. Some of our unexplained collisions with mountain tops could easily have happened in this way.

From still other studies by Fitts, Jones and Milton, of the pilots eye movements during instrument flying, it is known that pilots spend an average of about four-tenths of a second each time they check their altimeter. Compare this with the time it took for actual quantitative reading of this instrument as shown in Fig 1. When pilots are on instruments, the hasty four-tenths-of-a-second look at the altimeter is not long enough to read this complicated instrument.

As a result of these studies of errors in reading altitude, the Air Force has a new altimeter under development. It will use the indicating principle of the center instrument in Fig 1, namely a combination of a sensitive pointer and a counter. The counter gives altitude in thousands of feet. The pointer, as on the present instrument, adds the hundreds. Instead of the counter window being at the top, as in Fig 1, it will be at the left side. To provide this new type of presentation, a new instrument mechanism must be developed and thoroughly proved.

Until an improved altimeter is developed in quantity, a matter of several years at best, pilots should be on guard against the hazard of misreading the present three-pointer instrument. The greatest danger is in reading the altimeter too high by either 1000 or 10,000 ft. When letting down on dark nights and under instrument conditions...read it right.●

## QUIZ ANSWERS

1.—16,080
2.—13,960
3.—13,330
4.—10,700
5.—34,640
6.—25,420
7.—28,020
8.—1100
9.—11,000
10.—11,100

# SPARE THE SPACEMAN

ONE thing about scientists—they're always thinking. And all this high-I.Q. mulling results in some very handy devices. Things like immersion suits, radar and APC tablets keep rolling out of the laboratories.

Recently science, in the person of Dr. Fritz Haber, has been considering a new problem—escape and survival at high altitude. No handy devices have been invented to cope with high altitude bailout, but apparently a lot of thinking has been done.

The thinking started with a fascinating fictitious situation. You are flying one of tomorrow's supersonic rocket planes, tooling along at 60 miles above the ground. An explosion shatters the eerie silence inside the cabin. The aircraft is rocking crazily, out of control. What do you do next?

Well, in a World War II propeller-driven crate, maybe 10,000 feet up, you'd have climbed over the side and hit the silk. In a *circa* 1954 jet, say at 40,000 feet, you'd have squeezed a trigger that tossed you out of the cockpit, then waited serenely until an automatic gadget opened your chute for you at a safe altitude. But this won't do at 300,000 feet when you're traveling 10 times the speed of sound.

Not that you'd have any trouble getting out of the aircraft. Dynamic pressure of the air itself decreases as you go up. The very factor that permits a rocket to attain such speed at great heights will allow you to leap over the side. But then how do you get down to earth?

First of all, you'll need some kind of suit or capsule to supply pressure and oxygen. You won't be able to breathe unassisted or stand the temperature of your own body until you reach the denser air far down below. (Remember that above 63,000 feet the air pressure is negligible, and your blood will boil at normal body temperature.) It therefore seems likely you will wish to reach denser air without further ado. How about free-falling in your capsule down to about 20,000 feet, where an automatic chute opens?

Unfortunately, this is not as good as it sounds. In a free fall from 60 miles straight up, without any appreciable air pressure to brake it, a body plummets faster and faster until, like the rocket it just left, it attains a velocity several times the speed of sound. Now the speed itself doesn't hurt you. But when you hit the earth's cushion of dense air at about 100,000 feet, you throttle back to around 120 mph. This deceleration in our hypothetical case would resemble the shock of belly-flopping into a swimming pool, except magnified many times. If you come charging into this heavier air from well out in space, the impact could run as high as 300 G. Quite a crash!

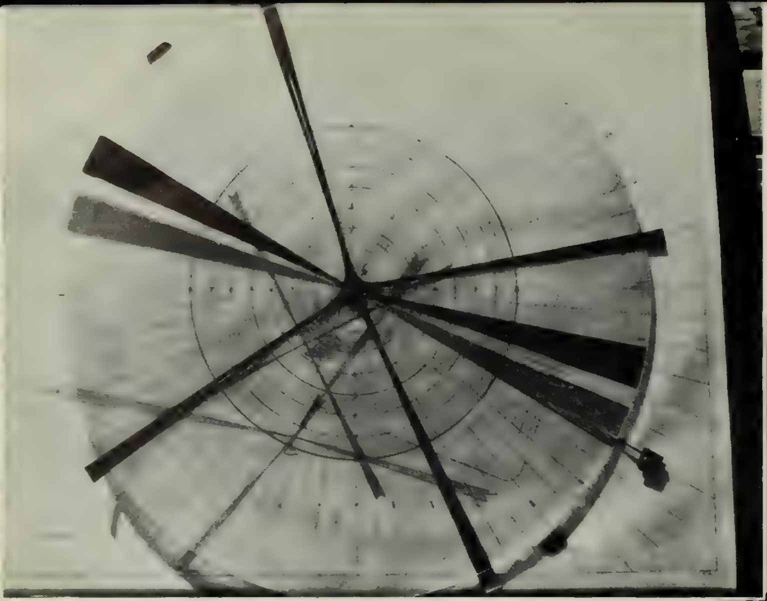
With that little capsule equipped to travel slowly down to 100,000 feet, dive gently into the denser air surrounding the earth and then float you to the ground, everything would be dandy. With a peanut butter sandwich and a good book in your pocket, it might even be a relaxing pause in the day's business.

But there's still another problem. When you bailed out of your rocket you were moving horizontally at a clip in the neighborhood of 6000 mph. Before you reach the ground from a height of 60 miles, you will have traveled about 250 miles beyond the spot where you bailed out. If you happened to be passing over Syracuse, heading for New York City, you'd come down 50 miles offshore in the Atlantic. This may make it a little rough for Air Rescue to fetch you home.

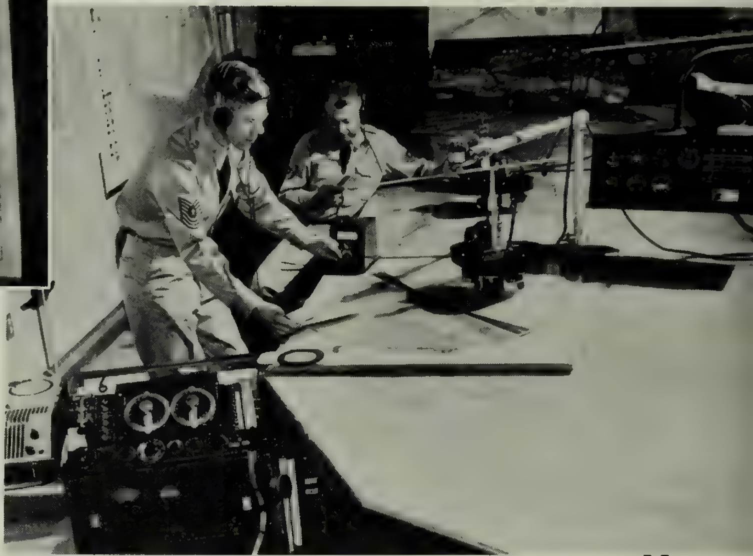
Well, as yet no one has invented a self-braking capsule for this kind of fall through space. Dr. Haber, who made some complicated calculations and came up with the conclusions mentioned here, has compiled his studies into a project report just published by the Air Force School of Aviation Medicine at Randolph Field. Title: *Escape and Survival at High Altitude.* Until recently a member of the School's department of Space Medicine, Dr. Haber is now a practicing engineer in Baltimore and accustomed to conjecturing on problems of this sort.

With one thing and another—although Dr. Haber doesn't say so—your best bet in this situation very likely would be to ride your wounded rocket down to 40,000 feet before you leave it. Provided there's something left of it to ride.

However, by the time you get around to filing a clearance to cruise at 60 miles altitude and 6000 mph, that cozy capsule or some other protective device no doubt will have come out of the laboratories. Something that will allow you to bail out up there, and survive. ●



Left, The Universal Radio Aids Navigation Board can be used to brief and teach pilots Omnirange procedures, to set up beam bearings for ILAS, GCA or radio compass. Below, the authors use a Hi-Speed table and board during an Omnirange Link exercise.

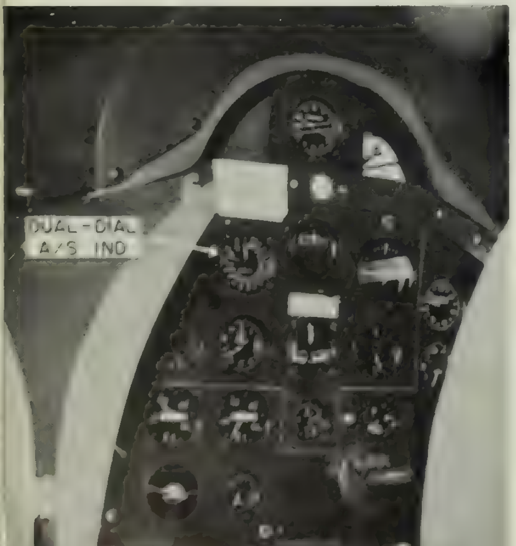


The instructor's standard C-8 Link direction indicator modified to become an Omni Resolver Simulator. This is used to help simulate Omni range approaches and cross countries.

# OLD LINK... NEW LOOK

**By M/Sgt Paul H. Woods and**
**T/Sgt Merritt Hickman**
**Instrument Training Branch**
**Edwards AFB, Calif.**

Link cockpit with dual-dial A/S indicator.

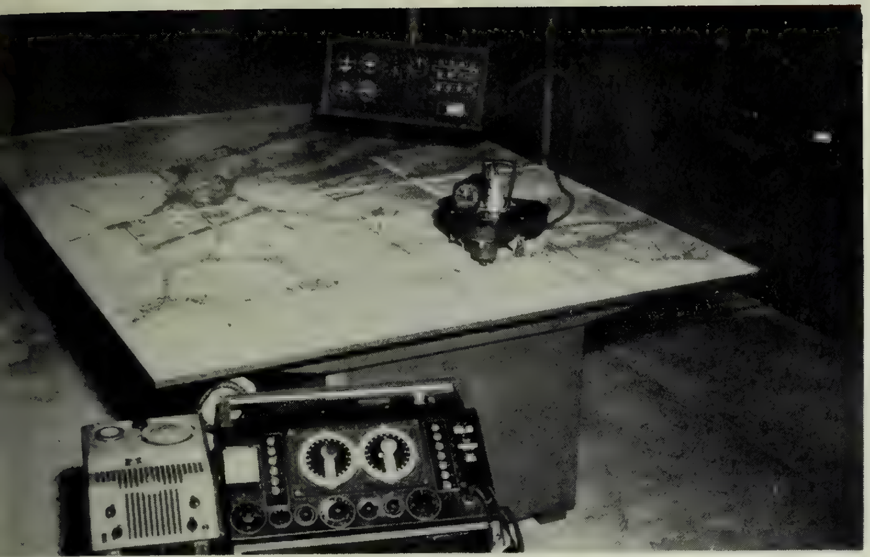


*With the Civil Aeronautics Administration placing development emphasis on Omnirange, and the cessation of low frequency four-leg ranges wherever possible throughout the INSAC system, familiarity, training and transition on Omnirange navigation and letdown procedures become increasingly important to USAF pilots.*

*The USAF is converting steadily to Omnirange in many aircraft, notably in the new B-25 modification program, and although Omni is simple to operate, and simpler to understand, it must be seen in action to be appreciated. A good place to initiate pilots on proper use of Omnirange is in the flight simulator.*

*M/Sgt Woods and T/Sgt Hickman have succeeded in modifying the C-8 and the ANT-18 Link Trainers to simulate Omnirange navigation. They believe their modifications and innovations can save the USAF both defense dollars and training time. These modifications require no special training for the operator, and because the main feature of the C-8 Omnirange system is its simplicity, hundreds of hours of training time have been logged without a single malfunction.*

*Their Omnirange board is an excellent visual training aid for use with any type instrument trainer. It can be used in classrooms or for individual briefing of pilots before and after flying an exercise. It demonstrates clearly the different flight paths in respect to selected bearings and terrain features as well as showing the sensitivity and directional qualities of the course indicator.*



The Hi-Speed table top covered with standard USAF sectional charts under plexiglas. These charts cover the entire West Coast and can be used for any given cross-country problem.

WE designed our Universal Radio Aids Board and Omnirange addition for the C-8 and ANT-18 Link Trainers to bridge a definite gap in our training facilities. We asked pilots what they thought was needed and designed the equipment to meet requirements and requests suggested by men experienced in instrument flying and radio navigation.

The board combines low frequency range, ILS, GCA, radio compass and Omnirange patterns. With it there is a limited cross-country chart that can be drawn to scale for certain congested areas providing maximum instrument and navigation procedures. The board dimensions are 48 inches x 36 inches x 3/16 inches. It is made of Masonite with a standard radio compass QDM chart mounted on it. Pieces of circular plexiglas with a three-foot diameter are mounted on a shaft or pivot in the center of the board. By drilling only half way through the top sheet it is possible to have a smooth surface over the radio station. Four low frequency beams, interposed between the two plexiglas sheets are connected to the center shaft and are free to be rotated to any course. The beams have a center slit for accurate alignment on the compass rose; the station-to-field bearing and fan markers can be plotted on the glass with a grease pencil.

On the bottom piece of the circular plexiglas we etched the standard visual beam of the VAR and VOR. This two-course beam is approximately 20 degrees wide from the edge of the blue to the edge of the yellow markings on the ID-48 indicator in the C-8 trainer. This is also the approximate width of the Omnirange bearing sensitivity for the same ID-48. We used it further as the standard ILAS localizer beam by scaling it down for the two and one-half degrees color indication from the center position of the localizer needle. A calibrated glidepath is marked off on the beam so that in conjunction with the altimeter, mounted on top of the recorder, the standard ILAS glidepath or GCA glidepath can be transmitted either visually or aurally to the pilot.

This circular disc is rotated to any approach bearing selected for ILAS, GCA, VAR or Omnirange approaches. The top disc is locked stationary so that any movement of the bottom when selecting courses will not disturb the relative position or progress of the flight recorder. The top disc can be taken off easily so that low frequency range legs may be removed or replaced as desired.

During Omnirange problems, an automatic radio compass bearing transmitter is aligned on the transmitting station to simulate Omni bearings to the Radio Magnetic Indicator or a VHF compass and for low frequency radio compass work.

The basic requirement for the Omnirange addition was accomplished by the installation of the necessary functions on the instrument panel. This includes the TO-FROM indicator and the Omni Bearing Selector. The third component, the ID-48 indicator (the standard cross pointer ILAS indicator) is used as is; the basic principle of flying the Omnirange with this instrument is the same as with the USAF version of the new cross-pointer instrument, the ID-249 indicator. On the ID-48 instrument, the localizer needle is directional as long as the pilot makes sure that his magnetic heading is within 90 degrees of the Omni bearing selected.

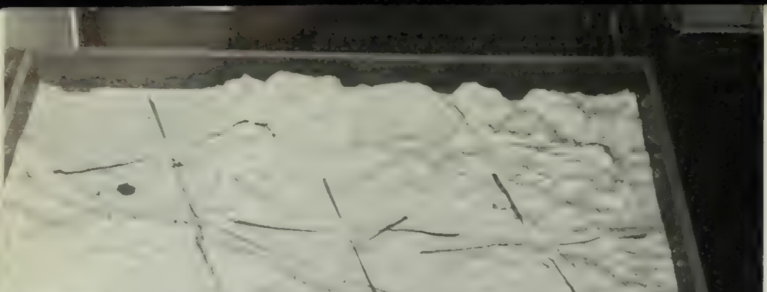
The TO-FROM indicator is a small electro-magnet and mechanical arm which moves the indicator "To" or "From" when energized. In the de-energized position of the relay the "To" is in view as this is the position indicated longest on a flight to a station. The indicator is mounted directly above the Omni Bearing Selector in a window cut out of the plate that mounts the selector. This selector consists of the radio compass bearing transmitter, the compass rose knob being operated by the pilot and the selected bearing indicated on the receiver teletorque in view of the instructor.

The Omni Resolver is an instrument designed to tell the link instructor exactly which BLUE-YELLOW or TO-FROM signals to give the pilot at all times. No matter how complex the changing situation may become, the output is clear and readable to the instructor. This instrument combines the receiver indications from the pilot's Omni Bearing Selector and the instructor's input of magnetic bearing to the station, which are referred to a set of wing-tips representing both the BLUE-YELLOW and the TO-FROM situations.

### C-8 Modification for Hi-Speed Problems

We made several modifications to the C-8 link trainer to simulate high speed navigational flights. No attempt was made to simulate jet engine operation but the actual planning necessary for jet navigational flights is present in the modified trainer.

We replaced the trainer desk with a large table top measuring eight feet by six feet, which stands 31½ inches high. The table top is covered with standard USAF sectional charts under plexiglas. These charts cover the entire west coast of the United States. Actually all types or sizes of training charts can be used as there is plenty of room for two or more charts which



## RADIO AIDS TERRAIN MAP

Sgts. Woods and Hickman believe that sometimes the longer way around may prove to be the shortest distance between two points, at least when it provides a wider margin of flying safety. To prove their point they have designed and built a projection terrain map of the local and surrounding Southern California area. They have found that this map is an effective training aid to present a panorama of this locale to new or TDY pilots assigned to Edwards Air Force Base.

They state, "This map takes the place of many words and much imagining. Terrain flying, in this area, requires continuous flight planning and caution, and combined with weather, the problem is doubled. The terminal area in the Los Angeles-Riverside vicinity is a triple threat in instrument weather during the winter months when violent Pacific storms move inland. The rest of the year has ideal VFR conditions except for some coastal fog and a pilot might tend to get careless. Then, when a heavy storm moves into the area, all heaven breaks loose.

"The venturi effect of winds in the Cajon and Beaumont passes sometimes reaches planes flying as high as 18,000 feet. Combined with possible altimeter errors this severe turbulence plus icing could mean bad trouble for any pilot.

"Our map, designed to allow a pilot to learn the area the easy way, is scaled approximately four inches to the mile and has a vertical scale of terrain on a six to one ratio. A pilot may reconnoiter this high terrain from any angle, as the map is mounted on a special stand with casters for easy moving and rests 25 inches above the floor at the front, with an additional 18° elevation at the rear. All airports and emergency landing fields are designated and VOR, L/F ranges and airways are located to scale, using colored tape. The overall result gives a lasting impression of 48,000 square miles of Southern California terrain, complete with high peaks, deep valleys and flat desert. Pilot comment has been highly favorable for the map and we feel it can be used to advantage in any locality where terrain is a factor in safe flying."

may be desired for a given cross-country problem, or for GCA or ILAS work.

The automatic recorder can reach any area on the table top without extension, while the radio console is mounted on a stand with casters so that it can be rolled around the table by utilizing a 10-foot extension cord.

The recorder cable conduit support is utilized to mount the remote instrument box on a 10-inch flange so that it can be pivoted left or right through 90° for easy instrument reading conditions. We taped the recorder cable to the outside of the cable support part way, then passed it through an extension arm 15 inches above and beyond the remote instrument box.

The altimeter is mounted on the recorder to facilitate altimeter readings and close observations during GCA and ILAS approaches. The altitude reset switch and the rough air control switch also are located on the radio console.

Standard C-8 airspeed dials were replaced with dual scale dials calibrated in knots. This dual scale is calibrated on each airspeed dial on the link trainer panel and the remote instrument box. Outer scale numerals are painted silver for the conventional airspeed readings while the inner scale numerals are painted a bright yellow. The airspeed pointer was shortened a quarter of an inch so that all numerals can be read easily. The outer scale has the same speed relation as the original miles per hour calibrations except for the conversion to knots. As an example, if normal cruising was 150 mph, then the outer scale now reads 130 knots.

On the inner scale which is converted for high speed navigation on sectional charts, the reading is 312 knots when the indicator is in the same needle position as the 130 knot indication on the outer scale. The high speed inner scale is calibrated from the cruising position based on the scale of a USAF sectional chart. For example, on a high speed flight using the inner scale, indicated cruising speed at 15,000 feet is 312 knots. By setting the free air temperature to conform with the standard day temperature at 15,000 feet (approximately —15°C.), the true airspeed will be 395 knots or 455 mph. A minor adjustment on the lapse rate linkage makes it possible to draw full power of 36" manifold pressure for the desired indicated airspeed. Then the stall assembly and control loading are adjusted to fit the desired flight characteristics. Wind drift is figured in on a proportionate basis, also.

All voice procedure on these simulated cross-country flights is recorded. General procedures for air route traffic clearances, tower instructions, position report, weather and approach control sequences are played back for pilot and trainer operator self critique. The importance of quick, concise and accurate voice procedure is brought home to the pilot after he hears his transmissions and remembers how important they are on an IFR flight.●

# WELL DONE

## 2ND LT. WILLIAM G. FRISBIE

**479th Fighter Bomber Group**
**George AFB, California**

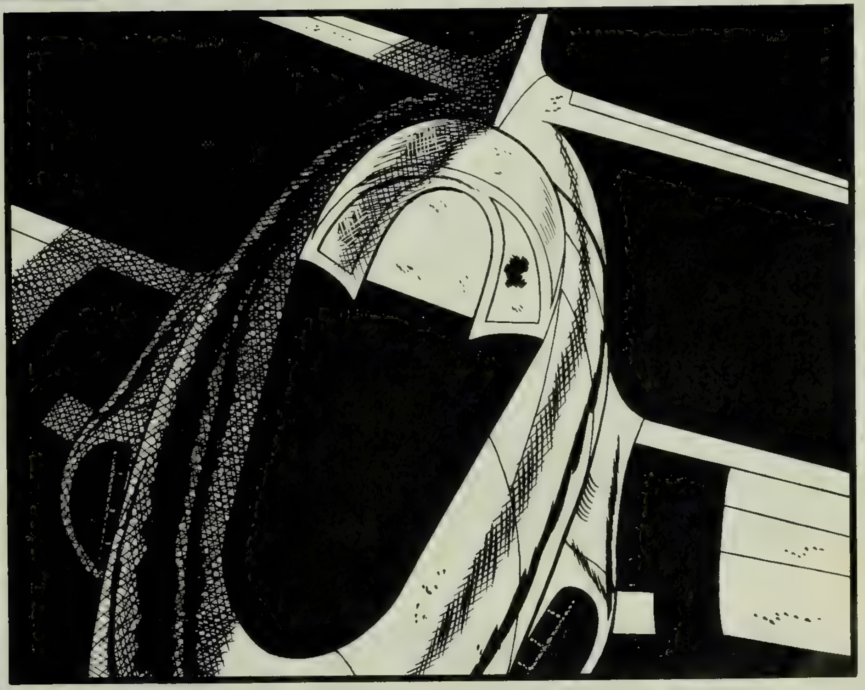
While flying solo at night from George AFB to Kirtland AFB in a T-33, Lt. Frisbie experienced complete electrical failure over Winslow, Arizona. Realizing he could not use his wing and leading edge tanks, Frisbie climbed to 44,000 feet to conserve fuel. He turned off all electrical equipment and used his flashlight to check his instruments.

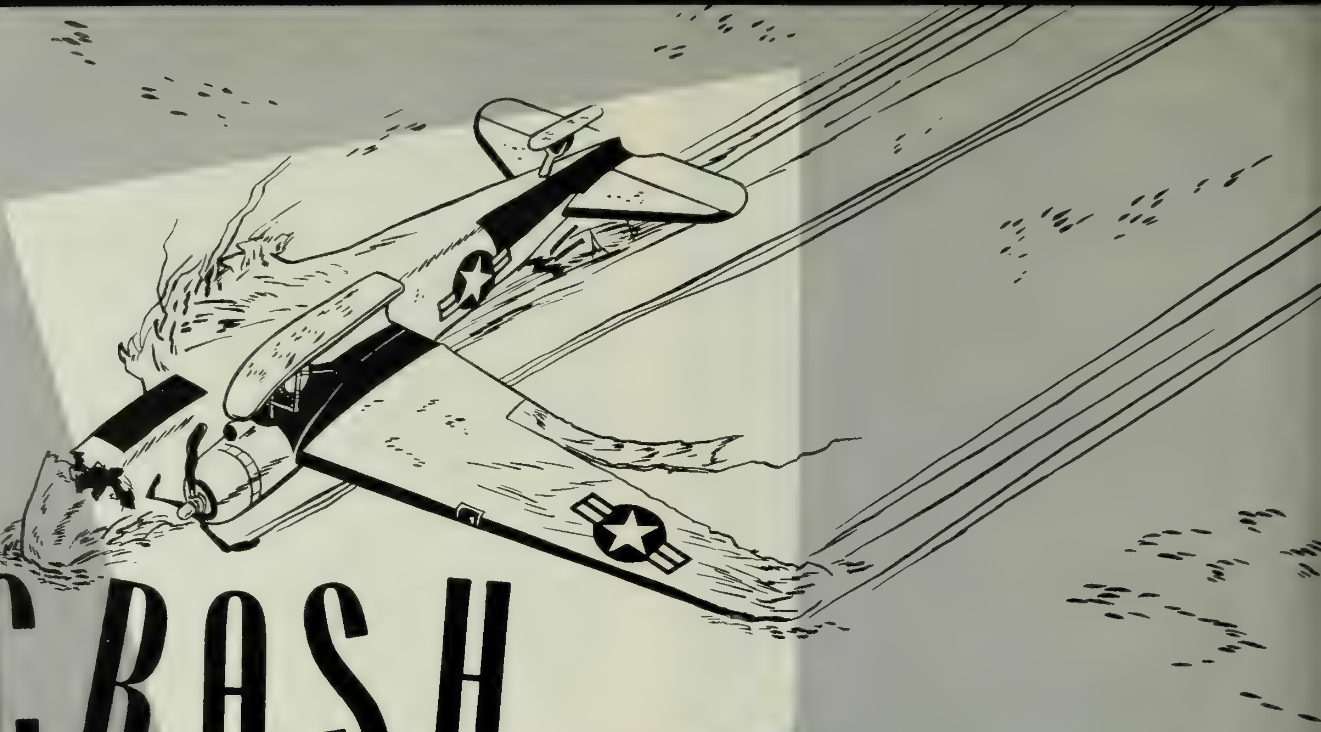
At 44,000 feet his canopy frosted over completely and he had to scrape holes with his fingernails to see. Without radio and with near zero visibility, Frisbie did a fine job of dead reckoning navigation and computing fuel consumption.

At Kirtland he dragged the field, rocking his wings to signify no radio, but the tower operator failed to see him. Frisbie observed an aircraft taking off and set up a pattern for the proper runway, with no flaps or speed brakes. His canopy was still frosted over and he decided against checking his airspeed for fear of getting vertigo.

Lt. Frisbie straightened up his aircraft just prior to touch-down by using the small clear spot on the left side of his canopy to see the left hand row of runway boundary lights. He made a successful, no flaps, no speed brakes landing and taxied in with approximately 50 gallons of available fuel. Well done, Lt. Frisbie!

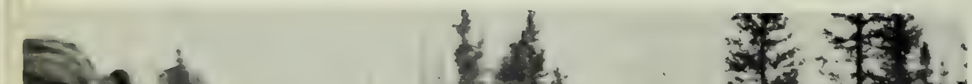
Frisbie had to scrape holes in his frosted canopy to land.





# CRASH and LIVE

Survival, following an Arctic crash, depends on initiative, knowledge of the crew.



"Knowing survival procedures and utilizing whatever is at hand... are vital to survival."

ARCTIC operations in ski-equipped aircraft present hazards not encountered in ordinary flight in more temperate climates. One of the primary hazards involves survival and protection of personnel in the cockpit after emergency or crash landings on ice and snow.

This accident story began with the unreliability of instruments in the Greenland area, coupled with the lack of means to obtain a proper altimeter setting over the desolate icecap.

An instructor pilot was on a check ride with a recently-arrived pilot who had no experience in Arctic flying. Weather was VFR and they were looking for a point where they were to make a landing. There was a slight difference between the readings of the two altimeters in the airplane, but since they were VFR the pilots had not been paying much attention to the instruments.

The weather over the icecap is famous for its quick changes, however. The pilots suddenly found themselves in IFR conditions with a white-

Snow houses, while hard to make, provide dry, warm shelter for airmen downed in Arctic.

out. They flew over but could not find the point at which they planned to perform the landing operation.

Instead of one of the pilots immediately focusing on instruments, *both* began to look out the sides of the cockpit in an attempt to locate the landing area.

The IP suddenly saw the point and told the pilot, who leaned forward and tried to look out the right window. Believing that he had sufficient altitude, the pilot began a turn to the right. When the plane rolled into the turn, the right wingtip touched and dragged the surface of the icecap.

The pilot tried to lift the wing and the left prop struck the ice. The right wing and prop then dug in and the entire wing and nacelle were sheared from the fuselage. The aircraft flipped over on its back, lost the left-prop, and then skidded upside down for about 150 yards before coming to rest. The cockpit was demolished and the instrument panels were torn loose.

Just as the right wing struck for the first time, the IP lost consciousness and recalls awakening and realizing that all was quiet and that he had pressure on his legs and abdomen. He did not realize that he was inverted, and released his safety belt which allowed him to drop and strike his head, causing unconsciousness from a second blow. The pilot remained conscious until the plane turned over — when he also sustained a severe head blow.

The flight engineer was sitting at the navigator's table and was knocked out on initial impact. Just a few seconds before impact, the radio operator had been called forward. He was momentarily dazed when the plane flipped over, but by the time the plane had stopped he was awake and active. His only injury was a small laceration on the forehead. He escaped through the hole made in the fuselage by the shearing of the right wing.

The problem of survival now became most important and rested with the radio operator alone. The weather was overcast, snow was blowing and the temperature was about 18°F.

All radio equipment was completely demolished and most of the aircraft was wreckage. The position of the site was not definitely known and the base could not be notified at the time of the accident.

If the radio operator had violated the first rule of survival and become panicky, all four men would have become casualties. He remained calm, however, surveyed his predicament and then systematically set to work.

His first job was to remove the three unconscious men. This in itself required almost superhuman effort because the pilots are six-footers and weigh about 200 pounds each, and were cramped in the cockpit under instrument panels. (The airman is 5′ 6″ and weighs 140 pounds.)

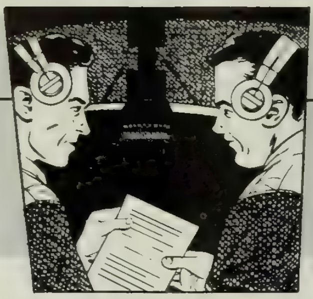
He managed to remove them safely and carry them about 100 yards from the plane. His next step was to provide comfort and protection from snow and cold. He partially undressed the injured men and made bandages for their head wounds from bits of his clothing because there was so much debris in the plane he could not find the first aid kits at once.

The plane had been carrying a cargo of food stuffs, including boxes of boneless beef, canned vegetables and dry foods. The cargo compartment had been crushed and was littered with so much debris that he wasn't able to reach the survival packs and personnel clothing bags at once. He had to unload many crates first. He carried these crates over to the men and arranged them into a protective shelter. After dozens of trips he was able to find some clothing, and then managed to get the injured men into sleeping bags and covered with sufficient blankets. Now he realized that he needed to insulate the sleeping bags from the snow and ice. In the cargo section he found large boxes of soda crackers. He emptied the crackers on the snow and arranged them into adequate pallets.

The airman was unable to fly the kite of the Gibson Girl, and after assuring himself that the now conscious personnel were in relatively good condition, he set off on foot to reach assistance. After about two hours of walking, he was still unable to locate help so he retraced his steps to the scene of the crash. He attempted to make the others more comfortable and opened cans of vegetables and allowed them to drink the juices.

After 10 hours, rescue was effected and personnel were brought into the hospital. Their condition was excellent despite their prolonged exposure and the shock of serious injury.

From the standpoint of flying safety, knowing survival procedures and utilizing whatever is at hand to minimize exposure to the cold, as this airman did, are vital to survival. Proper Arctic gear and know how are *musts* on even routine local flights.●



# CROSS FEED

LETTERS TO THE EDITOR

## Ramp Rubbish

The 190th Fighter-Interceptor Squadron, Idaho ANG, is being equipped with F-86A aircraft. At present our strength is ten F-86A's, one T-33A and three T-6's.

The parking space is adequate, but the construction of our new hangar has presented a problem of keeping the ramp area clear of loose debris.

Recently we borrowed a rotary sweeper from the Boise City Street Department and swept the whole area. Then the 116th Ordnance Company, Idaho NG, let us use its magnetic sweeper mounted on a Diamond T 6x6 which was used to follow up the sweeping operation, gathering the metallic debris not picked up by the sweeper. Here is a picture of the collection of the metallic objects, each piece capable of ruining the J-47 engine. Safety wire remnants were most prevalent but also in the collection were 50 cal. machine gun links, nuts, bolts and washers.

**Capt. Chauncey B. Reese**
**FSQ, 190th Ftr-Int Sq**
**Idaho ANG**

## The All Jet Issue

The special all jet issue of Flying Safety for December is a wealth of dope that every jet pilot should read and remember. I intend to keep a copy personally for ready reference.

To criticize any part of a fine publication such as this seems a bit superfluous. However, a couple of things were mentioned which are pet peeves of mine.

On page 6 at the end of the section titled "Flight En Route," it states: "The best power setting to produce the greatest range for the wind condition and altitude is shown in the Flight Operating Instructions Chart, as is the CAS and groundspeed to be expected from the power setting."

At the beginning of the next section, "Fuel Weight," it states to the effect that CAS will be lower when the airplane is heavier at the same power setting, etc.

Although the latter statement is true, the whole procedure will not give you the longest range for the least amount of fuel, and it is a common misconception.

It should be realized that for any given gross weight and altitude, an aircraft will have a definite pitch attitude which provides optimum efficiency. A direct indication of the pitch attitude is the CAS which, in the F-84 at normal cruise speeds, is practically the same as IAS. Therefore, the IAS as shown in the cruise charts should be religiously adhered to, while the power settings shown are only approximations. Now, it should be realized that the heavier the gross weight of any given aircraft, the higher the cruise IAS should be to maintain the optimum altitude. Therefore, after level-off at cruise altitude, the throttle should be gradually retarded and the IAS reduced (as shown in the cruise tables) as the airplane becomes lighter. Using alternate method, "Cruise Climbing," the original cruise rpm is maintained and the aircraft allowed to climb gradually rather than allowing the IAS to increase. This is the very best method since it takes into account engine compressor efficiency which is best at higher rpm.

The old concept of flying power settings may be good for piston types, but the power output of jet engines vary too much for the practical use of this ancient cruise control method in jet powered aircraft.

**Capt. William L. Skliar**
**523d Strategic Ft-Sqdn**
**27th S-F Wg, Bergstrom AFB**

*The information given in Captain Skliar's letter is correct. Adherence to CAS given in the charts will give maximum cruise regardless of power setting required. Cruise climb is the best.*

★ ★ ★

*The all-jet issue, December 1953, is being reprinted as a special study. Copies will be furnished the field as soon as they are off the press.*

★ ★ ★

## FC-10 Compound

I was especially interested in "Clear The Way!" on page 23 of your November 1953 issue. While this article does not say so, I'm sure that someone in the Air Force is familiar with the fact that FC-10 was developed by the Canadians and has been in use up there for quite some time on all types of military and civil aircraft. Also, quite a number of civilian pilots in the United States have been using this compound over the years. So far as we can determine at the moment, it's the best thing of its kind that has yet been developed.

I note that you've asked for first-hand reports of field experience with FC-10. Obviously, the Canadians have quite a few of them. And there are quite a lot of civil users in the United States who also could give you such first-hand reports.

**Max Karant, Gen'l Mgr.**
**Aircraft Owners & Pilots Assn.**
**Washington, D. C.**

## You're Not Well-dressed If Your Chute Doesn't Fit

★

This sweet, young thing seems to have a good fit in everything but her parachute. As she didn't jump from any airplane, that's O.K. However, such is not the case when you are way up in the blue. A good chute fit may save your life.

★

## THE RIGHT WAY IS THE ONLY SAFE WAY

# Mal Function

Please share this publication
With several other guys.
Don't be like old Mal Function
Who thinks he's really wise.

He'll hoard a dozen copies,
Even steal one from a pal.
But he never heeds the lessons
So don't be like our Mal.

This month we talk of patterns
And power approaches, too.
We hope this kind of info
Will prove a help to you . . .

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APRIL 1954

# FLYING SAFETY

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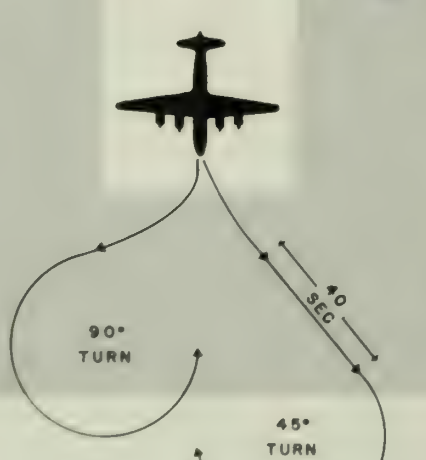
*The VOLSCAN Story . . . page 2*

*They crossed the field*

*.....they double-crossed it*

*.....they triple-crossed it....*

*and still they lost it.*



**MORAL: PRACTICE LOW VISIBILITY APPROACHES**

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# FLYING SAFETY

VOLUME TEN
NUMBER FOUR

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Cover: Interlocking steps in the Volscan system.

## SUBSCRIPTIONS

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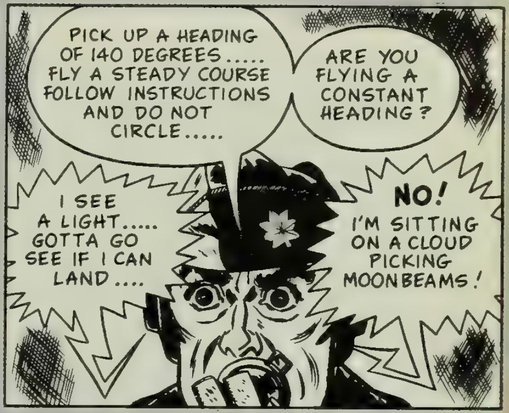
★ ★ ★

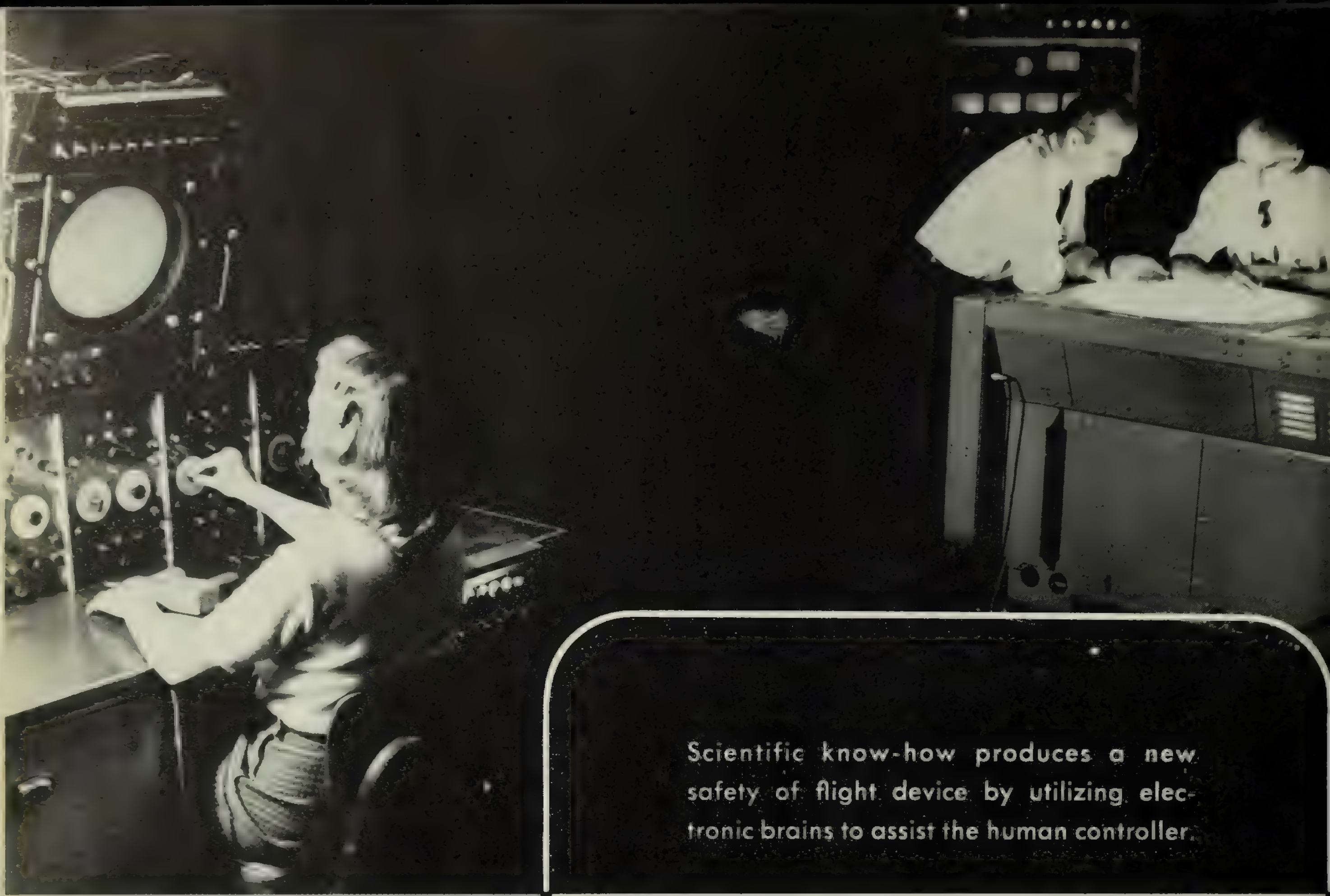
The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payment can be made for manuscripts submitted for publication in FLYING SAFETY magazine. Contributions are welcome as are comments and criticisms. Address all correspondence to the Editor, FLYING SAFETY magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Non-Air Force organizations must query the Editor before reprinting, indicating how the material will be used. The contents of this magazine are informational and should not be construed as regulations, Technical Orders or directives unless so stated.

USAF PUBLICATION 62-1

**In answer to many requests, Rex Riley appears on page 17. If you know of an accident or incident that would make a good Rex Riley, send it along. Include an outline, date and location. If your recommendation is used, Steve Hotch will send you his original artwork.**



PICK UP A HEADING OF 140 DEGREES..... FLY A STEADY COURSE FOLLOW INSTRUCTIONS AND DO NOT CIRCLE.....
ARE YOU FLYING A CONSTANT HEADING?
I SEE A LIGHT..... GOTTA GO SEE IF I CAN LAND....
NO! I'M SITTING ON A CLOUD PICKING MOONBEAMS!



Scientific know-how produces a new safety of flight device by utilizing electronic brains to assist the human controller.

Operators chart progress of incoming aircraft.

# VOLSCAN

## An Electronic Traffic Controller

A TYPICAL news release called it "a revolutionary electronic device for controlling incoming planes at busy air bases. Not radar; rather a combination of electronic tracking and computing units which are capable of automatic control of all planes approaching an airport." That was our introduction to VOLSCAN.

We decided that if this gimmick was half as good as the advertising, the Air Force was well on the way toward solving a knotty problem. Consequently, we packed up our long-johns, overshoes and coonskin coat and headed for Boston, home of the new seeing eye wonder.

January on the east coast can be chilly. In fact, it's downright cold — but any sacrifice for the readers of *Flying Safety*.

In a well-guarded underground bunker at Fort Dawes, near the entrance of Boston Harbor, we watched VOLSCAN in operation. It was contacting and guiding Air Force planes during test runs in the Greater Boston area. It was a startling demonstration, to say the least.

To an old GCA rider-inner, this system is an eye-opener in every sense of the word. VOLSCAN, developed in secrecy over the past five years, is an automatic system for bringing aircraft into an approach gate at precise intervals of as little as 30 seconds, where the aircraft is taken over by GCA for the final landing.

Thousands of test flights in everything from B-29s to F-86s have indicated conclusively that we're on the right track. If nothing else, VOLSCAN represents a definite step toward licking the stack-up problem and feeding existing landing systems. *Flying Safety* does not claim this is the final answer, but it's by far the best system we've seen to date.

This electronic system automatically does the job of the human traffic controller and with greater accuracy.

Traffic control personnel today are often forced to delay planes for long periods of time because of traffic saturation and stacking. The VOLSCAN system will do much to eliminate these problems, as will be described later.

Let us give you a quick picture of the unit itself before we launch into some of the technical details. You may as well read this report too, for sooner or later you, as an Air Force pilot, will be exposed to VOLSCAN.

The first VOLSCAN unit to be constructed is located on a cold and bleak island overlooking the tossing gray Atlantic. There is little in evidence to mark the site except a conventional radar truck. This bright yellow unit perches on a small windswept hill, its rotating antenna flashing at precise intervals as it twirls in the early morning mists. Outwardly the antenna somewhat resembles that of the familiar AN/CPN-18, which is now standard search radar equipment at many Air Force bases, but in this particular case is mounted on a truck rather than a fixed site.

However, several hundred yards away in an underground bunker are two rooms. One, illuminated only by dim red lights, contains the main control console and radar scope. Here, too, we find a large flat radar display panel also used for recording the performance of aircraft under control.

The other room contains the various electronic devices which make up VOLSCAN's electronic brain — glowing tubes, clacking relays and fast spinning gears. Inasmuch as this was our first glimpse of an electrical brain, we felt a bit shocked. Complex, yes. But still a very compact unit and not as awesome as we'd contemplated.

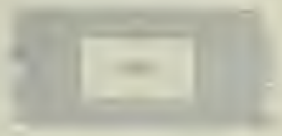
VOLSCAN is capable of controlling an entire area from one site. Thus, while we watched, aircraft were "fed" into several bases.

When the incoming aircraft were about 60 miles from Boston, they were seen by VOLSCAN's "eyes" — the radar — and their radar echoes appeared on the circular screen of the scopes in the bunker. The screen gives a map-like picture of the entire control area and the planes appear as tiny yellow dots moving across it.

Meanwhile, the planes have told VOLSCAN's "ears"—that is, the traffic operator — to which airport they are bound. The next move is for the operator to point a VOLSCAN Light Gun at the aircraft's signal on the scope. Instantly, a small square of yellow light, called a tracking gate, surrounds the radar blip. Each plane scheduled to land or under VOLSCAN control is inclosed by one of these gates.

As each aircraft's signal moves, the little tracking gate follows it, sorting out its data from that of all other planes and memorizing its position and velocity. These gates are produced by automatic tracking-while-scanning devices called "Antracs," which are VOLSCAN's memory cells. Even if the radar echo fades out, they will continue to move in accordance with their memory of the aircraft's past performance, thus predicting where the plane will appear when the fade has passed.

Just so that you'll get a better picture of this tracking gate, envision a radar blip surrounded by a square or oblong of light about a half inch in length looking something like this:



Remember, even if the blip fades momentarily, the little old gate keeps chugging right along across the screen. This is Antrac hard at work. Its electric memory is working up a storm and sure enough, even after a bad fade, the blip will appear again in the middle of the gate, right where it belongs.

Once the gate is tracking the aircraft's signal, the traffic operator pushes a button that starts VOLSCAN's cortex operating. This device, which is the reasoning and calculating section of the unit's brain, is called Datac. As an electronic traffic manager, it considers the plane's relationship to the airport and to all other traffic under control, and automatically selects a schedule that will permit it to arrive as early as possible at the approach gate and still prohibit a collision with other aircraft.

Safe arrival is the primary consideration and speed of arrival is secondary. Once it has selected the schedule, Datac continuously calculates control orders for the planes, consisting of headings to fly, altitudes, airspeed and the usual instructions such as reduce airspeed, lower landing gear and complete cockpit check.

Datac does not confine the aircraft to an artificial railroad-track type of path in the sky. Instead, it uses the plane's ability to maneuver and achieves its precise timing by changing the aircraft's heading so that it will fly a path just long enough to bring it to the final approach gate within nine seconds of its scheduled arrival.

Since data link (automatic coupling) is not yet available to all air-

**The Light Gun places a small, yellow square, called a tracking gate, around aircraft radar blip.**

**The path of each approaching aircraft is traced.**

craft. VOLSCAN now uses relay men, who merely read Datac's orders over a voice radio channel to the point. In this case, no apparatus is required in the aircraft except that which it normally carries. Eventually it is planned that such instructions will be fed directly into the automatic pilot, thus making this system truly automatic, with the pilot acting only as a monitor.

### Too Many Aircraft

When a major base is recovering its aircraft after a combat operation, the number of planes in the area can become prohibitively large, especially if there are other air bases in the area. The same problem exists around heavily congested areas where air traffic saturation is acute.

The mass of targets on the scope and the speed at which they are moving create a situation that can exceed the ability of even the most experienced controller using a manual system. He must identify each of these elusive blips, remember its identity while it weaves across the scope, guess at its distance, its speed, its heading, its possible arrival time and issue orders in hope of sliding it into a gap in the evolving pattern. And always hanging over him is the danger of rapidly diminishing fuel in jet aircraft at low altitude.

As we all know, a jet needs a great many gallons of fuel for a single go-around or if it encounters a traffic delay after dropping down to approach altitude. Therefore, once a jet starts its descent, it must be considered committed to land.

Under these conditions the visual estimation of distances from a PPI cannot be permitted except at very low traffic densities when large gaps can be left between aircraft to compensate for possible human errors in estimation. Therefore, automatic computation is the answer to the problem. This must be coupled with automatic retention of identity.

### A Closed Loop System

VOLSCAN is an automatic computation and control system. It is not solely radar.

Many Air Force bases are now being equipped with the AN/CPN-18 air traffic control and search radar. These can be connected to VOLSCAN, reporting to it periodically the position of all aircraft in the area.

At the expense of appearing repetitious let us enumerate the advantages of this new system. VOLSCAN includes automatic tracking-while-scanning channels called Antracs. At the control console an Antrac is assigned to each aircraft in the control area. Functioning as an automatic plotter, the Antrac isolates that aircraft's blip, follows its path and continuously reports its exact position to the computer. A channel of the VOLSCAN computer called Datac automatically selects a scheduled arrival time for the aircraft and calculates heading and altitude orders which will make good this schedule. Thus Datac is an automatic controller.

The Datac control orders are relayed to the aircraft by voice or, as noted previously, eventually will be sent automatically by Data Linkage for display on the Zero Reader or injection into the auto-pilot through a coupler.

As the airplane responds to the control orders, the radar reports all changes in its position, thus completing the loop. This closed loop control results in very precise management.

The heart of the VOLSCAN system is the Datac computer. This portion of the unit always selects for an aircraft the earliest possible time of arrival which does not conflict with aircraft already scheduled. Where such a schedule is possible, Datac issues a control order which heads the aircraft along the shortest possible path to the final turn circle, or a longer gradual curve, to establish time separation.

In case there is a conflict with another schedule, Datac selects the earliest later 30-second interval which has no reservation. Datac then orders the pilot to take a heading which is offset from the tangent path heading. Thus, as the aircraft progresses along this longer path, it is being delayed. As delay time drops, the magnitude of heading offset gradually reduces until finally, when the delay has all been taken, the aircraft, now on time, is on a tangent path.

In this way, by controlling aircraft headings, delays are gradually used up, and the aircraft are delivered to the entry gate with precise timing.

If this latter bit of information threw you for a loss, just look over the diagram entitled "VOLSCAN Heading Control." You'll note that each inbound flight path varies slightly. The aircraft closer to the entry gate are flying straighter paths. Those farther out are following greater curves. End result: they all arrive at the gate on time and properly spaced.

VOLSCAN can deliver aircraft to a final approach entry gate at the following rates — Jets: 120 aircraft per hour. Conventional: 100 aircraft per hour. The rate for mixed aircraft is lower than either type separately since aircraft must not pass one another either along the common landing path or in the funnel immediately preceding it.

### Adaptable and Flexible

VOLSCAN has been designed to integrate with existing and proposed USAF equipment. It does not require separate radar; it can be connected directly to any AN/CPN-18 unit. VOLSCAN can feed either GCA or ILAS with equal ease. It can function also without any final landing aid if weather conditions permit a minimum of 1000 feet and two miles visibility. These are arbitrary minimums established for test purposes only.

The tracking and computing equipment that make up VOLSCAN may be utilized in building, block fashion, to meet the needs of any particular installation. For example:

To achieve a traffic rate of 60 aircraft per hour with simultaneous automatic control of seven aircraft requires one Traffic Console and seven Antrac-Datac channels. If the traffic at this base increases, one additional console and seven additional channels can be added easily to give the full rate of 120 aircraft per hour with 14 planes under simultaneous automatic control. Thus the system can grow with the base.

Furthermore, one VOLSCAN channel contains only 60 tubes. Since a VOLSCAN air base installation consists principally of a number of such channels, it is not necessary to provide too many spares; each is a spare for the other. Therefore, maintenance is reduced to servicing a small number of simple circuits repeated many times—a far easier problem than most electronic installations.

We hope that we've made VOLSCAN's operation fairly clear to the uninitiated. We know that it sounds somewhat complex, but one visit to a control center or one in-flight utilization of the system will make a believer out of any skeptic.

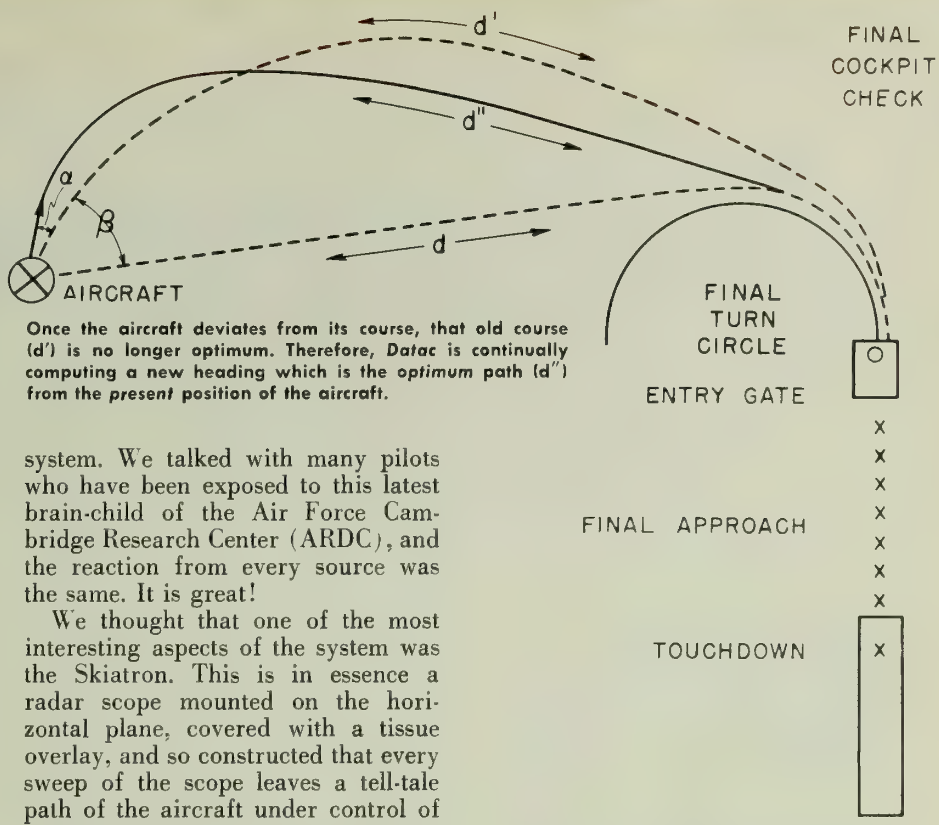
We had a long chat with Captain Bob Deiz, who has flown hundreds of runs, day and night and in all types of weather, on the VOLSCAN system. He's enthusiastic about the whole project and reports that it requires no special training — any pilot with a valid instrument card is qualified to fly it. There are no complicated holding procedures over a radio fix or on a beam leg. The approach to line-up with the runway is a smooth turn and gradual steady descent. The entire run from the beginning to GCA touchdown is a carefully polished, integrated operation.

Captain Deiz has a favorite story about VOLSCAN that we feel is worth passing on:

"To illustrate the need for the VOLSCAN system," he began, "one morning I took off with a 300-foot ceiling and proceeded to the VOLSCAN practice area. In one hour and 45 minutes I had made four VOLSCAN letdowns to VFR, in one case breaking through the ceiling at less than 100 feet. On leaving the practice area, I could not get a definite altitude assignment to the home station range, but was assigned 500 feet on top, which put me at 9000 feet.

"Arriving over the range I was notified that since I was eighth in order, my approach time would be one hour and 20 minutes later. During the period of holding, three jet aircraft arrived over the range and were placed ahead of all other traffic. It was not until one hour and 45 minutes after I reported over the high cone that I was able to land. VOLSCAN, 32 miles from there under the same weather conditions, could have landed all 11 of the various types of aircraft in less than 12 minutes."

Captain Deiz's story is typical of those who have flown the VOLSCAN system. We talked with many pilots who have been exposed to this latest brain-child of the Air Force Cambridge Research Center (ARDC), and the reaction from every source was the same. It is great!



**Once the aircraft deviates from its course, that old course (d') is no longer optimum. Therefore, *Datac* is continually computing a new heading which is the *optimum* path (d'') from the *present* position of the aircraft.**

We thought that one of the most interesting aspects of the system was the Skiatron. This is in essence a radar scope mounted on the horizontal plane, covered with a tissue overlay, and so constructed that every sweep of the scope leaves a tell-tale path of the aircraft under control of the console operator. The Skiatron operators can chart the progress of incoming planes and, by following the various flight paths, insure that there is no danger of collision. Every airplane under control leaves a purple trail visible on the tissue-covered viewing face of the scope, and the operators can actually "see" where every airplane is at any given moment. By tracing the flight-path trails with pencil, it is possible later to analyze all runs for accuracy and comparison purposes.

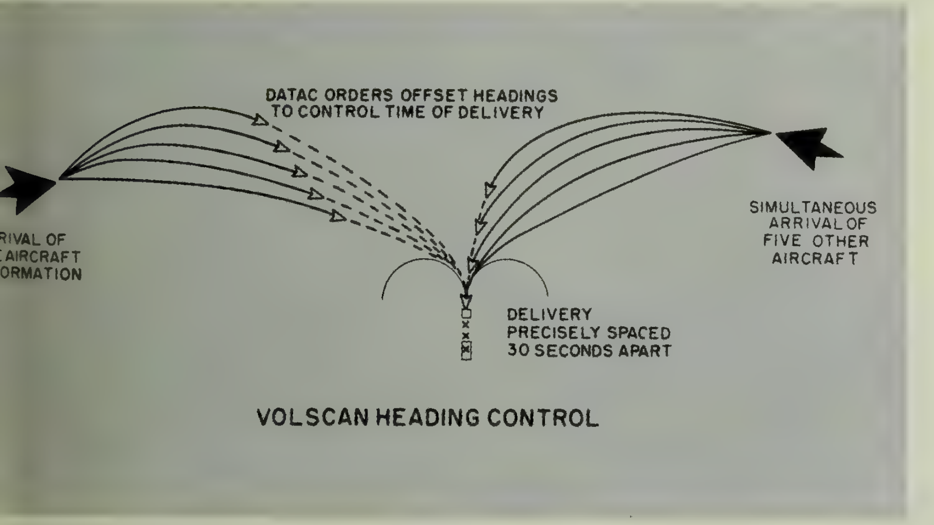
Just to give credit where credit is due, *Flying Safety* feels that a pat-on-the-back certainly should go to the project scientist who spark-plugged VOLSCAN. The entire project has been under the direction of Benjamin F. Greene, Jr. This genial giant of a man (a mere 240 pounder) is known to everyone as "Ben." He's a likeable, energetic sort of a guy who is completely wrapped up in his work and has spent the past five years in the development of VOLSCAN. We found that it didn't matter if one was wearing stars on the collar or stripes on the sleeve, Ben would launch forth into long and detailed discussion of VOLSCAN's possibilities at the first question. And, his answers are both interesting and understandable.

We do not wish to imply that VOLSCAN is any one man's brain-child. It certainly isn't. Cambridge is staffed with many brilliant electronic specialists, and they all had a part in the development of this new system. Basically, however, VOLSCAN isn't new. These experts have merely taken existing know-how and strung it together in the form of a new unit.

You can already see that this system, if adopted, can lead to drastic changes in present Airway Traffic Control procedures. *Flying Safety* will endeavor to keep its readers posted on all new development. If new ATC procedures finally become a reality, we shall bring them to you just as quickly as possible.

Remember the name VOLSCAN. We feel certain that you'll be hearing it used with increasing frequency. ●

**"Each inbound flight path varies slightly. Aircraft closer to the entry gate fly straight paths."**


DATAC ORDERS OFFSET HEADINGS TO CONTROL TIME OF DELIVERY
RIVAL OF
AIRCRAFT
ORMATION
SIMULTANEOUS ARRIVAL OF FIVE OTHER AIRCRAFT
DELIVERY PRECISELY SPACED 30 SECONDS APART
VOLSCAN HEADING CONTROL

# DITCHING

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THE Coast Guard, because of its long experience in landing seaplanes in rough water — both on rescue operations and in controlled tests — has always maintained a vital interest in ditching problems. As a result, we have developed certain procedures which now are accepted universally as standard by seaplane pilots. In most respects the landing of a seaplane and the ditching of a land plane at sea are similar, and these procedures can be applied to both. A study of numerous reports of ditchings by aircraft tends to confirm this.

Only a few years ago most pilots faced with a ditching situation simply turned into the wind and splashed in, often with rather drastic results. Today our pilots make a careful analysis of the sea and swell systems before selecting a landing heading; for in most cases the swell system, not the wind, is the governing factor.

A proper selection of landing heading may well be the difference between a smooth, easy ditching and a disastrous crash. Many pilots consider a night ditching to be a rather hopeless situation, but with proper procedures it is far from hopeless.

In a controlled ditching, even under very adverse conditions, the probability is that no one will be seriously injured on impact. Some may be lost evacuating the aircraft if panic is allowed to develop or the crew is not properly indoctrinated in evacuation procedures, but even this loss can be cut down with proper training. Once evacuation of the aircraft is accomplished, and with proper use of survival gear, rescue is virtually assured.

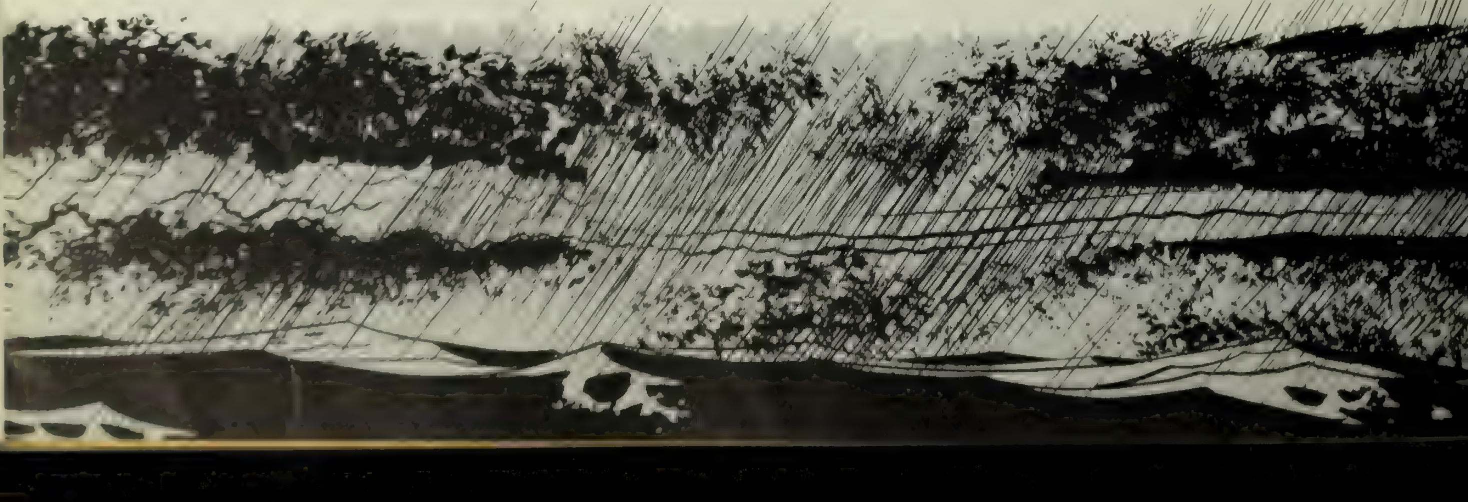
All this, however, depends upon a successful ditching, which in turn is dependent on the ability of the pilot to evaluate the sea and select a proper ditch heading. Considerable material on sea evaluation and day ditching has been presented in the past; therefore, this article will cover ditching under night and instrument conditions.

We may assume that a night ditching will occur when the distressed aircraft is alone, under escort of another aircraft or near a surface vessel. If the distress was reported promptly, the escort aircraft summoned will be a search and rescue aircraft, dispatched with necessary equipment. We can further assume that if the pilot has any choice in the matter, he will elect to ditch beside an ocean-station vessel which is trained and equipped to handle a ditching aircraft.

First let us examine a situation wherein the distressed pilot is by himself. To accomplish a successful ditching he must have information on sea condition and winds in order to select a suitable ditch heading.

If trouble occurs shortly after darkness, he may have a good idea of his best ditch heading from having observed the sea during daylight. We encourage our pilots to study the sea constantly during daylight hours and mentally select the heading they would choose if they had to sit down. This is not only good practice for seaplane rescue pilots, but it is good insurance for any pilot flying over the water. The chances are, however, that a pilot has not the slightest conception of the sea conditions if he has been flying at altitude and in darkness. He then must get the information on sea conditions from someone else, or he must see them for himself by flare illumination or perhaps by moonlight. Fortunately many ships at sea, and of course the weather ships, send in frequent weather reports including the sea conditions; this information can be obtained through the controlling Air Traffic Control Center. If they do not have it immediately available, they should be able to obtain it from the Rescue Coordination Center.

In a recent case, off the California coast, a pilot on a cargo flight lost two engines and realized that he would



## *This is the first of two articles dealing with ditching under night and instrument conditions.*

**by L/Cdr. John W. Waters, Jr.**
**U.S. Coast Guard**

be forced to ditch at night some 300 miles off shore. He requested a sea condition forecast. This was given by the Rescue Coordination Center on the basis of the best information available. The pilot set the DC-4 down in a beautiful night ditch without benefit of illumination. All personnel evacuated the aircraft and were picked up shortly thereafter.

It is apparent, however, that a sea forecast, based on scattered ship reports and under changing weather conditions, is subject to error. It would be far better if the pilot of the distressed plane could look at the sea himself.

In our search for a method to accomplish this, we assumed that our distressed plane would have only two flares available; this is the allowance usually carried by military aircraft (other than SAR types) and certain commercial operators. We also assumed that if the plane were in a ditching situation, its ability to maneuver would be restricted. The flares used were 600,000 candle-power aircraft parachute flares, Mk. 5, which have a burning time of three minutes.

To reduce maneuvering requirements, we tried dropping the flare at 2500 feet and descending straight ahead at 200 fpm. The resulting illumination was very poor, as the flare was astern and the water is only lighted between the observer and the flare.

We next tried dropping the flare at 2500 feet and circling the flare in a fairly tight descending turn. The water could be seen fairly well, but this method met with some objection from pilots who pointed out that it is difficult to evaluate the sea accurately when in a constant turn. Control of a crippled aircraft in such a turn was also pointed out as an additional handicap. With a low wing aircraft, the wing also tends to block vision in a constant turn.

The method finally settled on was a modification of one which was recommended by Coast Guard units in the Pacific. This consists of dropping a flare at 3000 feet, set to ignite 300 feet below the aircraft. After the flare is dropped, the plane is held on course for 10 seconds and then turned 90 degrees left, losing 300 feet in the turn. After rolling out of the turn, course is held for 30 seconds, then a turn of 180 degrees to the left is made, losing 600 feet in the turn. The flare is then dead ahead. The plane will pass the flare about 40 seconds after rolling out of the turn. The entire procedure takes two minutes and 50 seconds and the sea is clearly visible to the pilot for two minutes.

Only two turns are needed, both descending; this allows for a safe margin of airspeed even with a crippled aircraft. If the aircraft is capable of climbing again, the pilot can judge the sea better by descending below 2100 feet. A word of caution on passing the flare: the flare always looks closer than it is, but to play safe pass it to the side. Look down at the water, not directly at the flare. After passing the flare, shift back to instruments.

After the sea condition has been determined, choose your ditching heading. Then take up a heading 90 degrees to the left of the ditch heading, altitude still 2100 feet, and get set to ditch. Cockpit check should be made and all preparations for ditch completed. When ready, drop the second flare and remain on the heading for 10 seconds, commencing descent at 1500 fpm. At the end of the 10 seconds, turn 90 degrees to the left, still descending at 1500 fpm. When this is completed, you will be on the reciprocal of the landing heading or the downwind leg. Hold this leg for 30 seconds, continuing the descent. At the end of this 30-second leg, turn 180 degrees to the left. This turn might well be called the base leg; as you enter it, slow your descent rate to about 500 fpm.

From this point on, the approach will be by visual reference. As you approach the water, slow your rate of descent further and roll out of the 180-degree turn at about 200-300 feet, with the flare 40 seconds ahead. Ditch straight ahead by the light of the flare.

It cannot be emphasized too strongly that the pilot must touch down before reaching the flare. If the plane is held off the water too long, it will overshoot and pass from the area of good illumination into darkness, with results which can be imagined. The best touchdown point is about 400 yards short of the flare. There must be no hesitation in getting the plane down to the water. Landing lights may be used at the pilot's discretion, but are not recommended as they are of little help and produce a blinding glare.

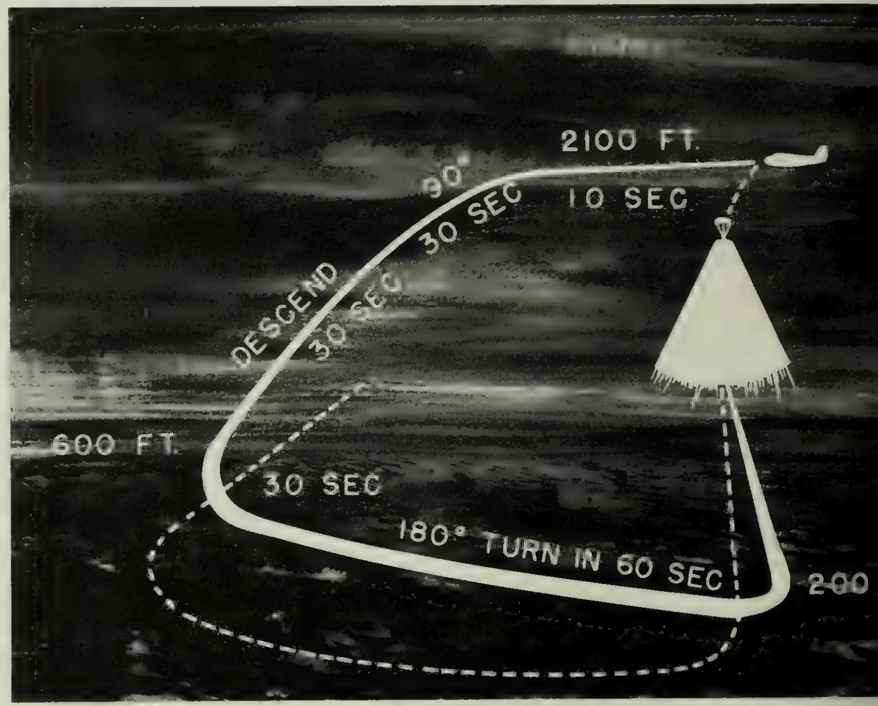
It should be noted also that a rapid descent in the early stages of the letdown will allow a gradual descent near the end with less chance of inadvertently flying into the water. We recommend left turns, because the aircraft commander is usually in the left seat, and this allows him to observe the sea during the entire approach.

If the pilot of a distressed aircraft is fortunate he may have an escort with him at the time he ditches. This escort may be any commercial or military aircraft that happens to be in the vicinity, or it may be a search and rescue aircraft with special equipment.

In order to find the most suitable way for an escorting aircraft to assist a distressed craft to ditch at night, a series of tests were conducted off Bermuda using one of our aircraft as the escort and another as the distressed plane. From these tests we derived a method which we consider simple, easy to explain and effective.

After intercept, the escort takes station one mile astern and 500 feet above the distressed plane. This provides good radar reception, for visual contact is very difficult to maintain at night or in clouds when the aircraft is ahead of the escort. From this position, the escort can commence his illumination plan at any time it becomes necessary.

If ditching becomes imminent, the escort remains one mile astern but does not descend below 3000 feet. The altitude of the crippled plane is immaterial as long as the plane is below 2000. The escort requests the distressed aircraft to execute a 360-degree turn, rolling out on the original heading. The distressed aircraft commences the turn, giving a mark at the time of turn. The escort continues on course, and as it passes the point where the distressed plane rolled into the turn, releases two parachute flares and a smoke float. When the cripple has completed about 100 degrees of the turn, the flare will light, and the surface of the sea will be visible during the remaining 90 seconds of the turn. This time should be used to evaluate the sea and select a ditch heading. After completing the 360-degree turn, the distressed aircraft rolls out on the original heading; the escort aircraft is now about three miles ahead. (During the entire operation, the escort transmits signals on a homing frequency of 514 kc, and the distressed aircraft, by tuning the ADF to this frequency, will always know where his escort is.) The escort aircraft is now in a position to commence illumination when called for; and if the present heading is suitable for ditching, no further turns will be necessary. The probability is, however, that the pilot of the distressed plane will select another heading for ditching. In this case, he advises the rescue plane.



**Recommended procedure when aircraft is ditched under its own flares.**

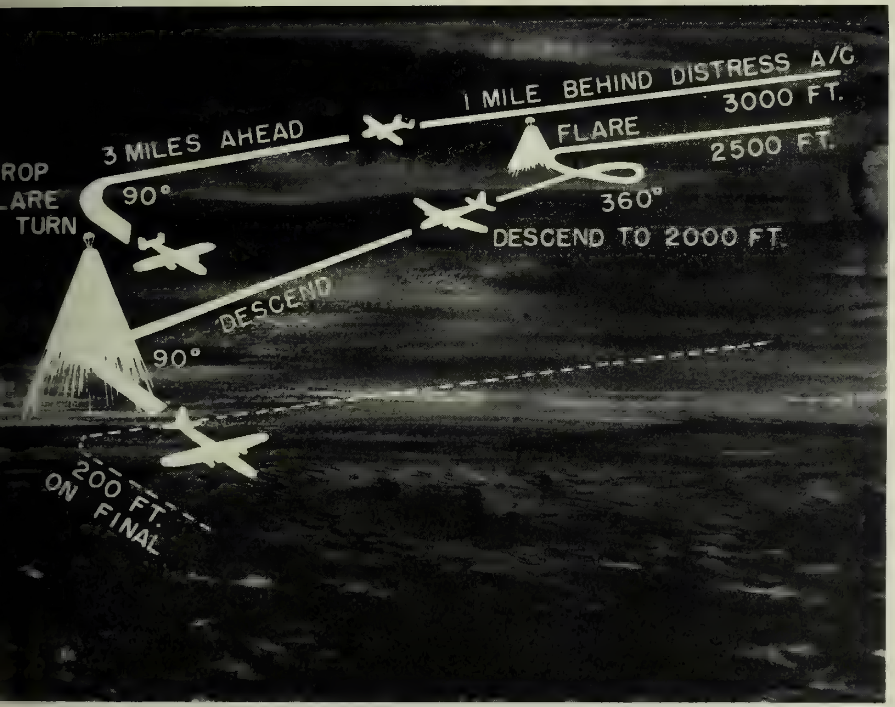
The rescue plane then turns to the ditch heading, dropping a flare and a smoke float as it starts the turn. This is primarily to mark the turn point for the crippled plane, but it also gives the cripple an additional minute to look at the sea. As the crippled plane reaches this flare, it turns onto the selected ditch heading also. The rescue aircraft is three miles ahead when the turn is completed.

At this time the distressed aircraft can commence descent for ditching. When the distressed plane calls for illumination (usually at about 300 feet altitude), the escort drops a line of five flares at 1000-yard intervals. With each flare a smoke float is dropped. The first flare will ignite two and a half miles ahead of the distressed aircraft, and all five will be burning when it is one mile out. The illumination totaling three million candlepower is excellent, and the distressed aircraft can ditch under conditions approaching daylight.

The escort aircraft, after dropping the fifth flare, turns rapidly to the left and parallels the flares on the reciprocal of the ditch heading. From this position the pilot can watch the distressed plane ditch and observe the impact point with reference to the string of smoke floats. Immediately after the ditching, the escort continues around in a race track pattern and drops a string of five more flares. There are now 10 flares, totaling six million candlepower, illuminating the scene while the ditched plane is being evacuated.

After dropping the second five flares, the escort commences a rapid descending turn to the left, passing under the flares and over the survivors at an altitude of 100 feet, dropping both bomb bays of survival and flotation equipment a few feet upwind. This drop will occur about four minutes after ditching, when all survivors should be out of the plane and still well grouped. Single flare drops are continued until all survivors are in rafts. We have thus provided for sea evaluation, illumination for ditching and evacuation of the aircraft, flotation and survival gear for survivors and a guard over the survivors until surface rescue units arrive, or until daylight when on open sea landing can be made by the rescue seaplane.

Recommended procedure when ditching area is illuminated by escort aircraft.



In discussion with a number of experienced airmen, both military and commercial, who have actually flown through this procedure, I have encountered only one objection. They believe the rescue plane pilot should make the sea evaluation and select the ditch heading, rather than the distressed pilot. Their reason for this belief is the general inexperience of the average land plane pilot in sea evaluation. We have agreed to modify the procedure to allow the rescue pilot to evaluate the sea. This is accomplished by having the rescue aircraft execute a 360-degree turn for sea evaluation when dropping the first flare. The distressed aircraft will then be required to make two 360-degree turns instead of one, as the rescue aircraft must still move out ahead the required distance.

The more satisfactory solution, of course, is to have every pilot who regularly flies the ocean familiar with sea evaluation procedures and selection of ditch heading. In the procedure just discussed we have assumed the escort to be an SAR plane. But suppose the escort is a commercial aircraft which happened to be in the vicinity at the time. This has happened on several occasions.

If the escort has parachute flares, it can use a modification of this procedure knowing that it will have only two flares. One of these should be used for sea evaluation and the other for final ditching. If the escort has no flares, it can assist by dropping down low and estimating the sea by whatever light is available. Use of landing lights is, however, a hazardous and doubtful procedure, and not to be undertaken lightly. Once the distressed aircraft has ditched, the aircraft must fix the position and remain on top as long as possible, dropping available survival gear.

There is one other possibility if two or more SAR planes are en route to intercept. The plane nearest the distressed unit will continue and complete the intercept, while the other SAR plane evaluates the sea by means of flares and advises the distressed plane of the best ditch heading.

The question will probably arise as to the effectiveness of this procedure during conditions of low ceilings and reduced visibility. To be frank it is only fair, but still far better than no illumination at all. In clear weather the flare is normally dropped at 3000 feet. It ignites at 2700 feet. If there is a low ceiling, this procedure must be modified; otherwise the illumination from the flare will be dissipated long before the flare drops below the base of the cloud. With a ceiling of 600 feet, for example, we would wish the flare to burn out at 400 feet, or 200 feet below the base of the clouds. This is accomplished by dropping at 2100 feet instead of 3000. While it burns only about 15 seconds below the cloud base, it will give off considerable illumination while still in the cloud, due to diffusion of the light.

It is not recommended that the flare burn below 400 feet in any case, due to the blinding effect and danger of igniting gasoline on the water after ditch. In this connection you may object to the smoke floats we drop as a potential fire hazard because of the open flame. Tests show that flares drift away from the smoke floats. If a ditching is made under the flares, you will be clear of the smoke floats, which, however, will be invaluable as a reference for the impact point. In this article, I have been referring to the U. S. Navy Mk. 5 parachute flare. If a different model is used, procedures must be modified as necessary to fit the performance of the flare. ●

# PLANNED for the PILOT

## The Zero Reader — How it works and how to use it.

**By George Huss**
**Field Service Engineering**
**Sperry Gyroscope Company**

MILITARY pilots are, as a rule, expected to participate in the most exact kind of flying. There is little or no room for error. Aircraft speeds are faster. Performance is higher. Missions are more complex. A pilot handles more information. But less time is available to receive, interpret and use this information.

Concepts that simplify this information problem are much sought after. The problem is almost as old as the instrument panel. Many attempts have been made to meet this challenge and almost as many new instrument concepts have ended up in the museum.

Two approaches have been common. One has been to design indications that make it easier for the pilot to visualize his flight path. Another has been to combine indications to gain more efficient presentation and to save panel space. Both are based on presenting existing facts about actual attitude and position of the aircraft to the pilot. After visualizing his flight path he must decide what to do.

Now, a new concept has been introduced. It tells the pilot what to do how to move the stick to attain and hold the desired flight path.

This principle originated in the Zero Reader Flight Director developed by the Sperry Gyroscope Company in 1948. It has proved thoroughly successful in the worst of weather flown by the Air Transport Association, Sperry flight research aircraft, and the USAF All-Weather Flying Division. Today this basic instrument is being employed both as a flight instrument and as a low-approach instrument in many types of aircraft, particularly in USAF interceptors.

The flight director tells the pilot how to accomplish something that has not yet occurred. It directs him into the desired flight path. This is how it works:

The flight director combines information from the basic flight and navigation instruments; yaw from the directional gyro, heading from the compass, roll and pitch from the vertical gyro or gyro horizon, altimeter data and the radio navigation information of the localizer, glide-slope and VOR. From this, it computes the control information necessary to direct the pilot into the desired flight path. This information is presented on a simple two-element indicator that tells the pilot directly how to move the controls to reach and maintain this path.

### Operational Principles

Except for controlling speed by application of power or speed brakes, control of the aircraft can be reduced to two elements; turning right or left and nosing up or down. This is true of all phases of flight, including precise instrument flying, air traffic control, radar interception and instrument approaches and landings.

This principle is fundamental to operation of the flight director. The indicator gives only two instructions: Fly Right or Left and Fly Up or Down.

The pilot finds that as soon as he has moved the controls enough to give the amount of pitch or bank computed by the flight director, the indicator zeros immediately. As long as he moves the stick to hold the indicator on zero, his airplane will turn neatly into the desired climb, heading, track or other desired flight path without any overshoot. It will hold the plane on the path as long as the indicator is zeroed. Further, if diversions cause him to stray from the desired path, simply moving the stick to zero the instrument again will promptly bring him back.

The revolutionary feature of the flight director is that the pilot is provided with an indication that permits him to fly and navigate the airplane manually with a degree of accuracy, precision and ease that approaches the performance of automatic control. Hunting and overshooting of the desired flight path are eliminated.

In the past, the pilot flying manually has been obliged to consider the values of five different elements of flight and navigation information: altitude, heading, pitch and bank attitude, localizer deviation and glide-slope deviation. He has had to take these values, some or all of which may at any one time be in continuous change, weigh them against one another, and calculate the necessary movements of the controls. These calculations have had to include the rate at which the actual flight position and attitude approached the desired conditions so that anticipatory movements of the controls could be made. The flight director makes all of these calculations automatically. No anticipation is necessary. The pilot merely follows the indicated pitch and bank commands directly as they occur.

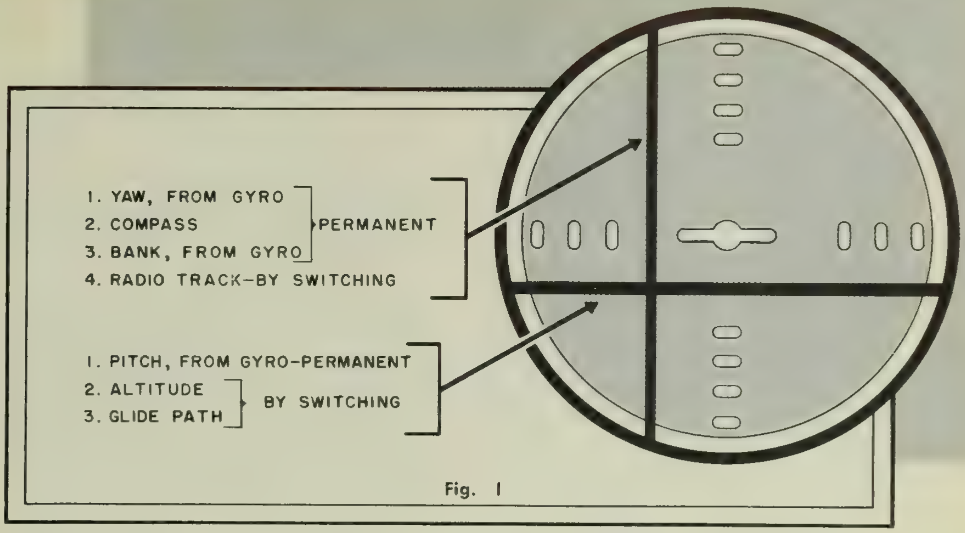


Fig. 1

Evolution of the flight director to meet special requirements of different aircraft operations has produced three versions for use in military aircraft. Type A-2 is the one in principle use today. This consists of four major components: indicator, selector switch, control and radio rate unit. The A-2 indicator is a panel-mounted instrument which combines the indicator element and the heading selector of an earlier commercial version. This indicator has two distinct advantages. Heading information is presented on a large, easily read dial, built around the indicator element, and the combination precludes mounting the heading selector in an inconvenient cockpit location.

The selector switch can be mounted in any location that is easily accessible to the pilot during flight. The control and radio rate unit are usually inclosed in a remote section of the aircraft.

The sensing of the indicator is such that the pilot always flies the center of the indicator toward the bars. For example, if the horizontal bar is two marks above center, the pilot raises the nose of the aircraft by back pressure on the stick or control column until the bar returns to zero. If the vertical bar is displaced to the right the pilot banks the aircraft to the right.

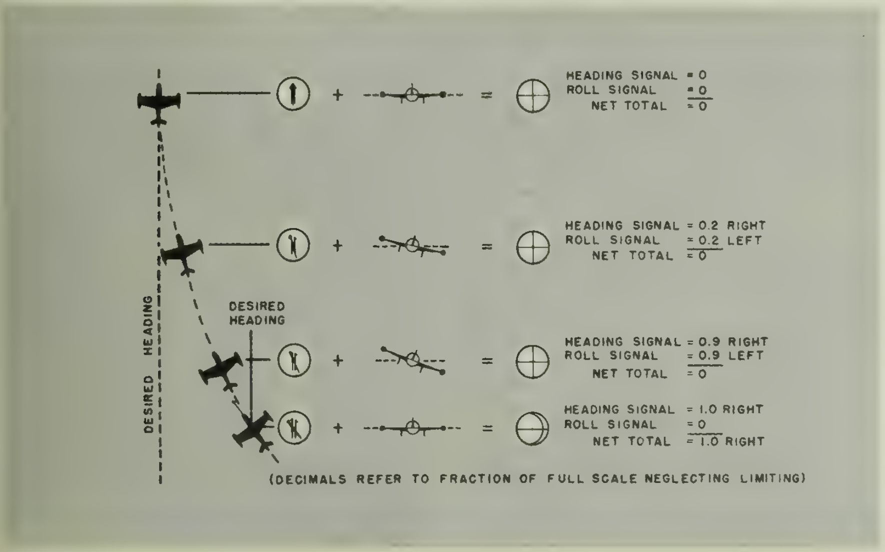
It is important to note here that the indicator can read zero on both the horizontal and vertical bars, and yet the aircraft will not necessarily be level laterally or longitudinally. This is because the instrument does not give any fundamental data as to what the aircraft is doing. It only indicates to the pilot that he is flying according to some pre-selected plan.

### Control Limits

To what extent will the flight director allow you to change the attitude of the aircraft and still remain on zero? This has all been precomputed within the control unit of the flight director system. The limits have been determined from actual flight test data taken under the most adverse weather conditions by both the All Weather Flying Division of the Air Force and the Sperry Flight Research Department. The limits chosen were approximately 30 degrees of roll for jet aircraft and approximately 25 dgerees for transport aircraft. The pitch limits are 10 degrees for both jets and transports.

Operational simplicity of the flight director is presented in Figure 2, which shows how to turn to a new heading. Assume that a takeoff has been made on a runway heading of 250 degrees and the desired heading after takeoff is 160 degrees. After the aircraft becomes airborne, gear and flaps retracted and a minimum safe altitude attained, set the desired heading on the flight director. This causes the vertical bar of the indicator to deflect to the left. This vertical bar deflection tells the pilot to Fly Left! As the aircraft begins to bank, the needle begins to return to center or zero. When the vertical bar returns to zero, no further bank is required. The bank angle is in the neighborhood of 25 to 30 degrees, as determined by monitoring the gyro horizon.

**Fig. 2. This illustrates the proper way to use the Zero Reader to turn to a new desired heading.**



When the airplane begins to approach the desired heading, the needle begins to move slightly to the right, indicating that the bank should be decreased sufficiently to return the needle to zero. Nearing the desired heading, the heading signal demand diminishes; therefore, the computed bank angle also diminishes. A computed presentation of this type results in a smooth, pre-planned and ever decreasing turn to a new heading.

Throughout this maneuver no anticipation of the instrument is required of the pilot. There is no lag or lead. The turn is completed exactly at the point planned as the flight director is relieving the pilot of a series of mental computations.

The flight director system does not replace any of the conventional instruments normally mounted on the aircraft panel. It does, however, relegate these instruments to a standby or monitoring system. The flight director reduces the required instrument scanning time to a minimum. The pilot has more time to attend to radar, navigation, gunnery, bombing, fuel scheduling or any other problem necessary to accomplish the mission. Fundamentally the flight director is a flight instrument. It is designed to make accurate instrument flying easier and more feasible for pilots under the most adverse weather conditions

### Flight Director Versatility

The versatility of the flight director is such that many uses can be made of it. Excluding the more special applications, the following are some of the common or conventional uses for the flight director:

- Instrument takeoff.
- Turn to initial GCI heading and transition to best climb speed.
- Climb and transition to level flight.
- Expediting turns made to new headings.
- Descent and transition to level flight.
- Accurately maintaining altitude.
- Flying VOR radials.
- ILAS approaches.
- GCA approaches.
- VOR and L/MF range approaches.
- ADF approaches.

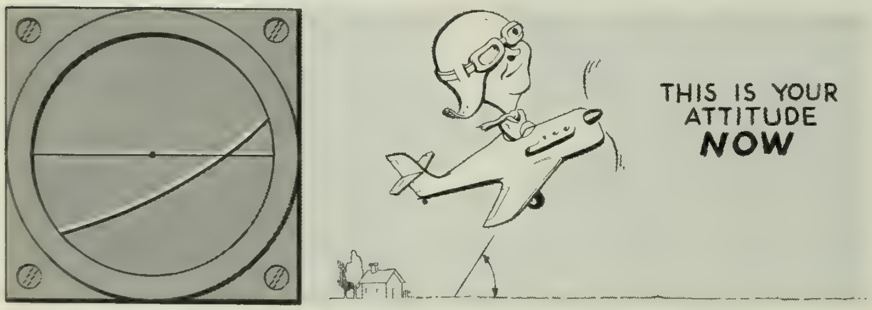
It is beyond the scope of this article to go into detailed procedures of all these uses, even though the flight director can be used to equal advantage in each. The following ILAS approach can serve as an interesting example of how the flight director can enable the pilot to succeed under adverse weather conditions. This example deliberately avoids what is considered a standard ILAS approach to emphasize the versatility of the flight director. It points out how an approach procedure can be adapted to fit traffic or geographical problems that may exist in any location.

Assume that a jet aircraft is returning from a mission in which the fuel supply is nearly exhausted. The aircraft is at an altitude of 25,000 feet and there is a solid overcast from 20,000 feet to 500 feet. The pilot is flying a heading of 240 degrees, homing on the middle marker of the ILAS system by means of ADF and is cleared for approach. The flight director is set to 240 degrees, the selector switch set to FLIGHT INSTRUMENTS and the altitude control is on.

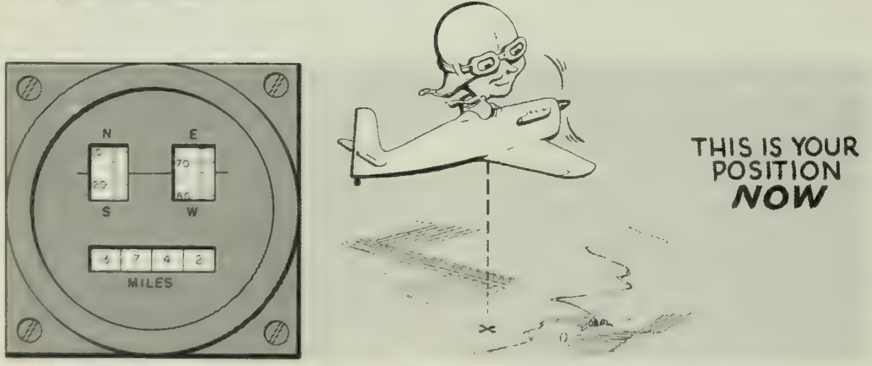
Referring to Figure 3, note that from A to B is approximately 15 miles. While flying from A to B the pilot is concentrating upon his radio, map, fuel scheduling and checking altitude while maintaining attitude. From B to C the pilot wants to maintain the exact heading that he had been flying prior to arrival at point B. During this time he is tuning his ADF to the LOM frequency. He desires a radio bearing to the outer marker which will give him an intercept angle with his present heading at some point beyond the outer marker where he can start a standard rate turn to the right to intercept the beam edge. Also, during this phase of the approach the pilot is concentrating upon any configuration changes of the aircraft, any additional radio tuning that may be required, watching his fuel supply and making his letdown.

### Descent and Approach

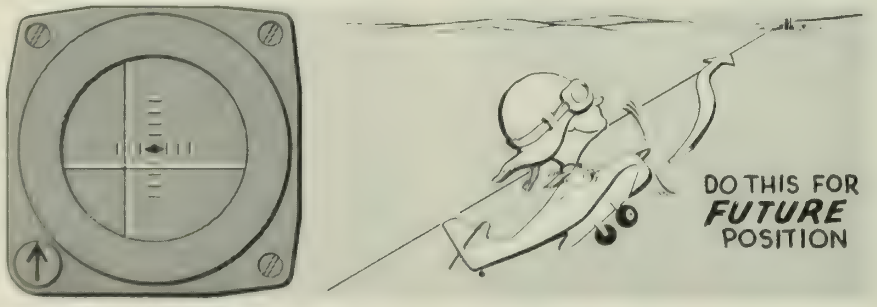
The descent is accomplished by setting the desired nose-down angle in on the pitch attitude trim knob of the indicator and then zeroing the horizontal bar. The pilot now intersects



FLIGHT INSTRUMENT

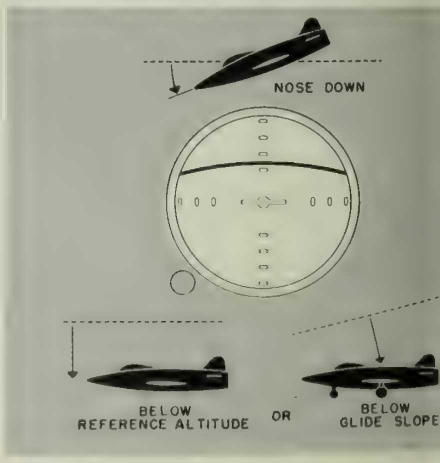


NAVIGATION INSTRUMENT



FLIGHT DIRECTOR

Fig. 4. Three reasons bar indicates "nose up."



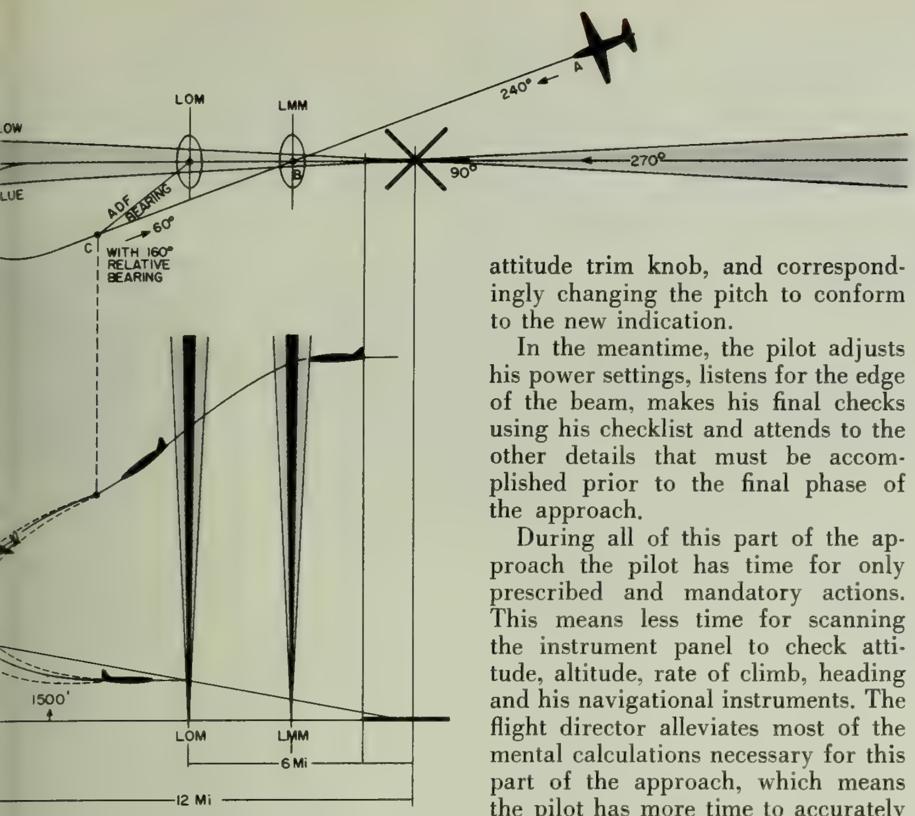
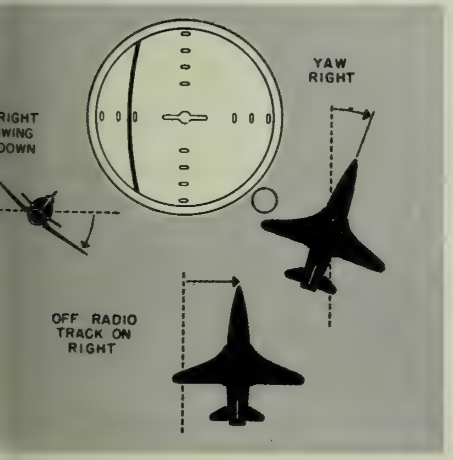


**Fig. 3. A diagram of flight described in text.**

his radio bearing to the LOM at point C and immediately starts a standard rate turn to the right. After initiating this turn, the pilot inserts a heading of 60 degrees on the flight director and flies the bars to zero. This means that the pilot is turning with a bank of 30 degrees and still descending at the rate he initially established. If he desires to change the rate of descent he can do so by increasing or decreasing the position of the horizontal bar with the pitch attitude trim knob, and correspondingly changing the pitch to conform to the new indication.

**Fig. 5. Reasons bar indicates "turn right."**



In the meantime, the pilot adjusts his power settings, listens for the edge of the beam, makes his final checks using his checklist and attends to the other details that must be accomplished prior to the final phase of the approach.

During all of this part of the approach the pilot has time for only prescribed and mandatory actions. This means less time for scanning the instrument panel to check attitude, altitude, rate of climb, heading and his navigational instruments. The flight director alleviates most of the mental calculations necessary for this part of the approach, which means the pilot has more time to accurately check the other requirements to complete his approach successfully.

At point *D* the pilot intersects the edge of the localizer beam. Immediately, he inserts the runway heading of 90 degrees on the flight director and couples to the localizer by turning the selector switch to Blue Right. Also, he watches his altimeter to determine the final approach altitude at which he must intercept the glide path. Once the altitude has been reached, he simply turns the altitude control on and reduces airspeed to gear and flap speed before reaching the outer marker. The descent signal inserted previously no longer is operative because the altitude signal has taken over.

The aircraft now approaches the glide slope as noted by the movement of the glide slope needle on the deviation indicator. When the needle of the deviation indicator reaches on course the selector switch is turned to APPROACH. The aircraft is now coupled through the flight director to both the localizer and the glide slope. The pilot concentrates upon keeping both the vertical and horizontal bars on zero, while monitoring the primary instruments.

As the approach continues, the localizer and glide slope deviation will be approximately on course. At the outer marker gear and flaps are extended and the aircraft is slowed to final approach speed. Drift on final can be estimated from the tower's reported surface wind. Correct the approach heading of 90 degrees for this drift. For example, if a crosswind of 10 knots exists and an approach speed of 120 knots is used, the estimated drift will be five degrees. Set the heading selector to either 85 degrees or 95 degrees, depending upon whether the drift is left or right. Computations for drift should be made prior to arriving at the middle marker. In the type A-2 flight director this drift correction is taken care of by the radio rate unit automatically when the selector switch is turned to APPROACH.

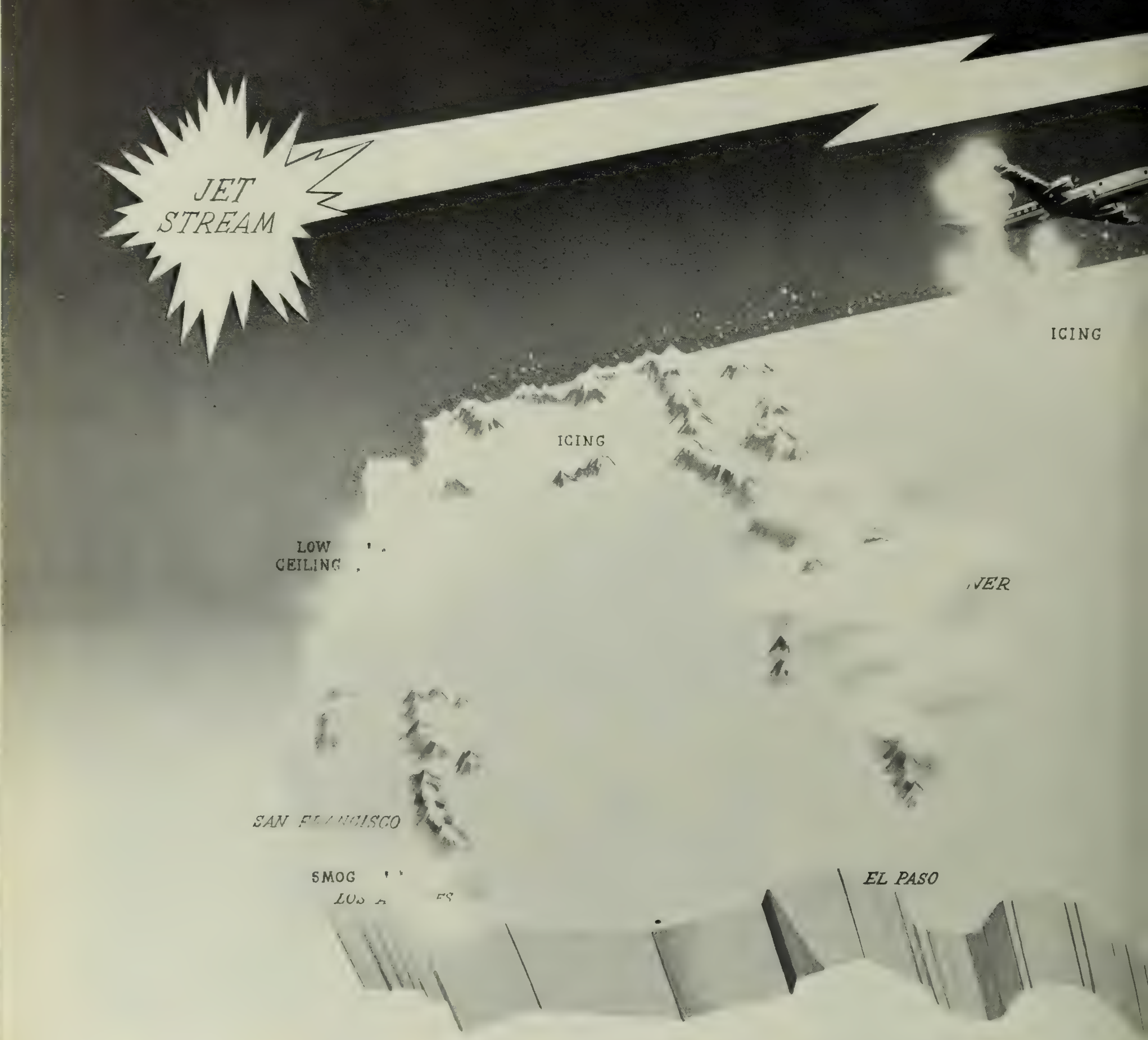
Somewhere near the middle marker the aircraft will break into the clear and the pilot will see he is lined up with the runway and ready to land. This type of approach may seem unorthodox but it is hoped that from this you will be able to derive some basic ideas for using the flight director for many types of approaches.

As experience is gained daily with the flight director, its value in all-weather flying and high altitude flying becomes more evident. In addition to the applications cited, it is being used for many special applications such as formation flying and accurate pitch references for bore sighting. Pilots like its simplicity, ease of operation, reliability and the ease with which they can adapt themselves to its use. In particular it aids precise maneuvers on instruments and permits aircraft to line up and land on the first approach. As illustrated, this is particularly desirable when the aircraft is short of fuel and arrives under low visibility conditions.

The examples throughout this article seem to indicate that the flight director is better suited for the jet aircraft, but this is not intended. Actually the flight director is installed in many types of transport aircraft, both military and commercial.

Reports from our field engineers indicate that the flight director is also being used for many special applications. They also report that pilots who have used this equipment like it. We are naturally encouraged by reports like this from the field, because we feel flight directors are here to stay. On one count alone — their contribution to flight safety on IFR — they've made a lot of friends among USAF pilots. ●

# Spring FLYING H



*This represents the first of a series of climatological briefs on the four main seasonal weather phases. The summary which appears in this issue covers in general terms the spring weather for the United States and will be followed by briefs on summer, autumn and winter weather at the advent of each season.*

*In addition, eight other articles are scheduled throughout the year, highlighting single weather factors of timely importance for the given month.*

*These articles are being prepared for FLYING SAFETY Magazine by the little-publicized Directorate of Climatology, Headquarters Air Weather Service, under the supervision of Dr. Woodrow C. Jacobs, Director.*

*The "book" says that climatology is the study of the collective state of the atmosphere at a given place or over a given area within a specified period of time. During World War II the need for such a meteorological agency, capable of attacking a climatic problem, evaluating the data and providing an answer, was recognized. Today, the Directorate of Climatology is the source for all long range weather needs and other weather data for both the Air Force and the Army.*

# ZARDS

By Capt Richard C. Burriss, Hq AWS
Capt Robert W. Sanderson, Hq AWS

Art Work by: S/Sgt. R. C. Guy, Hq MATS

*The Directorate has sources of weather information, both specific and general, almost beyond imagining. A case in point is the total of almost two hundred million cards containing weather observation data filed in the U. S. Weather Bureau-Air Force-Navy punch card library.*

*Many climatological requests for problem solutions are received both in the field and by Hq Air Weather Service. If the solution is beyond the capability of the field station it is forwarded to Headquarters. In general, there are three types of requests: (1) A solution to a specific problem such as the most suitable location for a GCA unit; (2) An analytical-descriptive study to indicate weather conditions affecting certain operations, plans or decisions such as weather conditions affecting helicopter flights over the North Atlantic; (3) A quantitative description of certain weather conditions or atmospheric events such as mean heights of the tropopause and associated phenomena.*

*The information on the following page includes an explanation of the weather map and a brief rundown on the types of accidents most prevalent during the spring months.*

THIS map indicates the major spring weather hazards and the areas in which they are most commonly observed. Under certain conditions these hazards could occur anywhere in the country at some time during the season.

During March, April and May, the weather over the United States is characterized by atmospheric instability, particularly over the Middle West and Southeast portions. A steady progression of cold fronts with accompanying squall lines sweep across the Mississippi Valley and into the Atlantic Coastal States.

A sharp increase in thunderstorm and tornado activity is noted in the spring. In March the area of maximum tornado occurrence is roughly a circle about 600 miles in diameter centered over northwestern Mississippi. This zone moves northwestward in April and becomes most intense in May when it is centered in eastern Kansas.

From 1916 through 1952 over 6,000 tornadoes were reported; more than half of these occurred during the three spring months. Kansas leads in number of tornado reports, while Iowa holds the championship for number of tornadoes per unit of area. Oklahoma runs both a close race.

About half of the reported tornadoes begin between 1400 and 2000 LST, and 82 per cent are observed between noon and midnight.

Thunderstorm activity is centered in the same areas but is much more widespread. Most thunderstorms form along fronts, but late in May the air-mass-type storm appears over the states bordering the Gulf of Mexico.

Low ceilings and visibilities are most frequent along the East Coast north of Washington, D. C., along the coast of Southern California, along the Washington-Oregon coast, over Southeastern Texas, over the eastern edge of the Rockies and over the extreme western portion of the Great Plains. In addition, certain industrial smoke areas, such as Chicago and Pittsburgh, have a relatively high frequency of restricted visibility.

Except in frontal zones and thunderstorms, icing is encountered most frequently over the states bordering Canada and the Great Lakes. The zone from 5,000 to 10,000 feet presents the greatest possibility of dangerous ice accumulation on aircraft.

The jet stream loses strength during the spring and begins a northward migration. It is encountered most generally over the southern half of the country at levels above 30,000 feet.

The preceding information gives a picture of the various types of weather phenomena which may be expected during March, April and May. Let's examine these conditions in terms of weather contributing to accidents.

The Directorate of Flight Safety Research has made an exhaustive study of accidents that were, in part at least, attributable to weather during these three months. This study covers a period of the past five years. Certain facts are particularly outstanding, and in general they are as follows:

An average of 17 aircraft per month during the reporting period were involved in accidents where weather was a contributing cause.

One phase of flight that came in for a large share of such accidents was the landing. Most of this could be attributed to strong, gusty cross-winds. Groundloops, nose-ups, dragging wings and loss of directional control all enter the picture. These figures alone indicate that a much more aggressive program is necessary on the part of commanders to insure greater pilot proficiency. After all, these are the windy months of spring and cross-wind techniques could well be a topic at the next flying safety meeting.

The in-flight phase of the study indicates that many aircraft have received extensive damage from hail while flying through thunderstorms and in some instances pilots have lost control and crashed while attempting flight through such adverse conditions.

Several cases are on record of pilots becoming lost during instrument conditions, resulting in fuel exhaustion and ultimate abandonment of the aircraft or landing on unsuitable terrain.

The following is a typical example of an accident where weather entered the picture and helped set the stage for a crash:

One day in May a flight of four F-80s departed a midwestern air base on a navigational training and weather penetration mission.

The aircraft became airborne early in the afternoon but were delayed in join-up for several minutes while the No. 3 man cycled and recycled a sticking landing gear. Finally, the four planes got into formation and proceeded on course.

At 3500 feet the flight entered clouds. Precipitation static made reception of the climb-out range leg impossible and the flight leader switched his compass to the loop position. He was then able to locate the null.

Visibility in the clouds was good and the flight continued in normal formation, position reports being made on channel "C." The flight leader reported passing 4000, 6000 and 8000 feet and received acknowledgment from approach control.

At approximately 9500 feet the leader turned 45 degrees to the left to position the flight for a procedure turn. Standard climb was maintained and at this time heavy rain was encountered with severe turbulence.

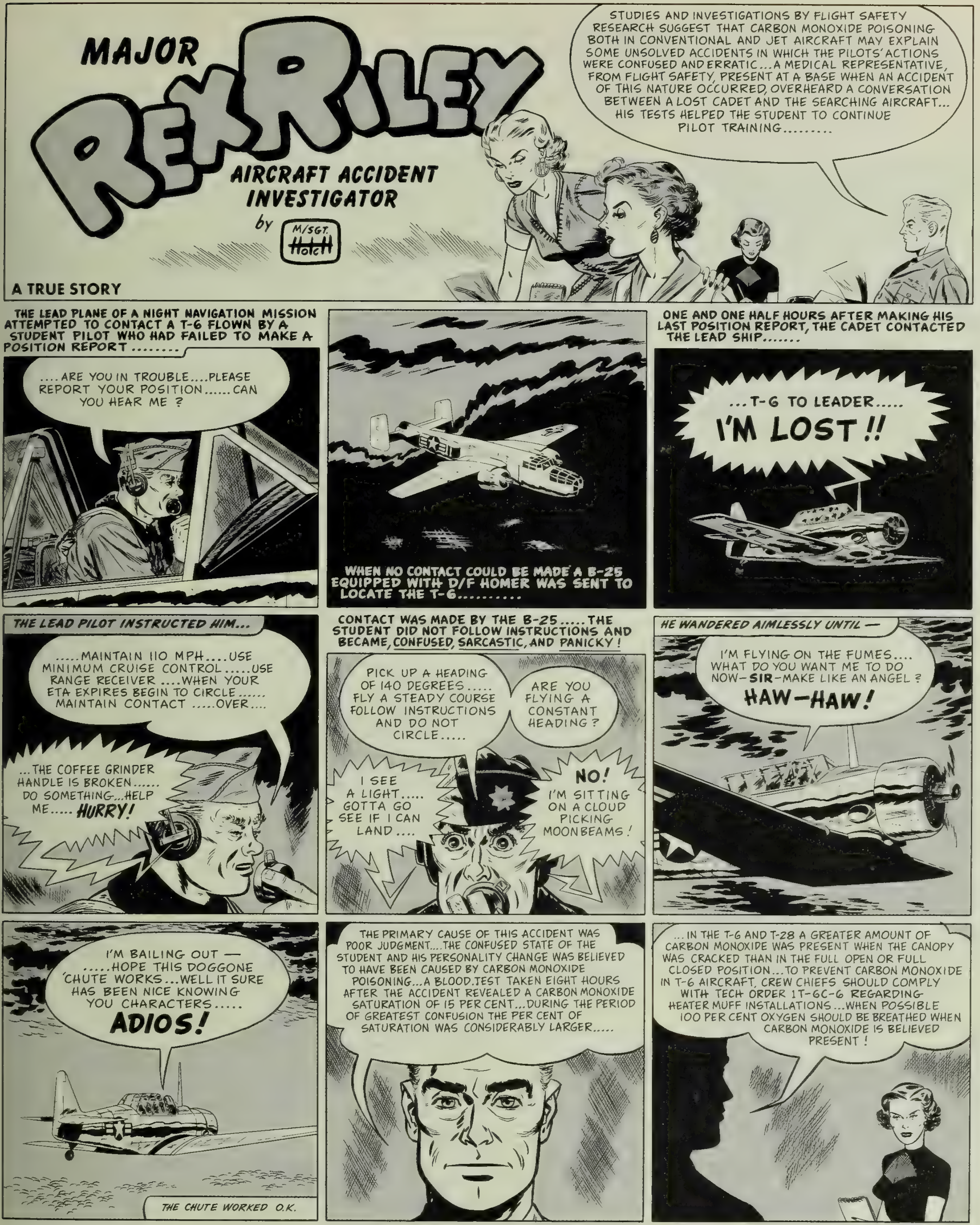
During a 180-degree turn to the right the flight leader was unable to check the positions of the rest of the flight since he was concentrating on his instruments and heavy rain had covered the windshield and canopy.

This was the last time the leader saw his wingmen until back on the ground. Here he found his No. 2 man. Number 3 apparently experienced vertigo and lost control of the aircraft. It went almost straight in. Number 4 definitely experienced vertigo when he lost contact with the aircraft ahead and then attempted the transition to instrument flying. The plane entered a spin from which he was unable to recover. He bailed out at 8000 feet.

These men had been briefed adequately on expected weather. The experience level should not have been a factor in the loss of two aircraft. Perhaps it can best be attributed to the vast difference between flying in fairly thin clouds and in actual weather. Rain and turbulence suddenly teamed up to call the shot.

Before either pilot could make the transition to the gages, both planes were thrown into unusual positions. After that, interpretation of the instruments seems to have become an impossibility.

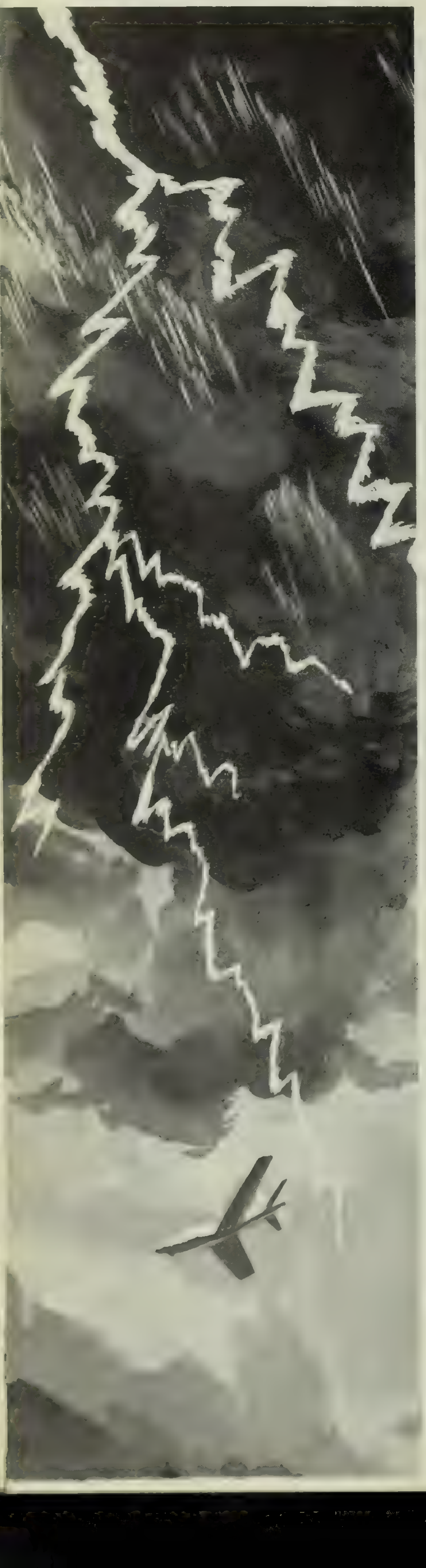
Don't let old man weather sneak in a Sunday punch on you. The monthly rundown of projected weather in *Flying Safety* will never serve as a forecast but it will alert you to the type of weather you may logically expect to encounter. ●


MAJOR
REX RILEY
AIRCRAFT ACCIDENT INVESTIGATOR
by M/SGT. Holch
A TRUE STORY
STUDIES AND INVESTIGATIONS BY FLIGHT SAFETY RESEARCH SUGGEST THAT CARBON MONOXIDE POISONING BOTH IN CONVENTIONAL AND JET AIRCRAFT MAY EXPLAIN SOME UNSOLVED ACCIDENTS IN WHICH THE PILOTS' ACTIONS WERE CONFUSED AND ERRATIC... A MEDICAL REPRESENTATIVE, FROM FLIGHT SAFETY, PRESENT AT A BASE WHEN AN ACCIDENT OF THIS NATURE OCCURRED, OVERHEARD A CONVERSATION BETWEEN A LOST CADET AND THE SEARCHING AIRCRAFT... HIS TESTS HELPED THE STUDENT TO CONTINUE PILOT TRAINING.........
THE LEAD PLANE OF A NIGHT NAVIGATION MISSION ATTEMPTED TO CONTACT A T-6 FLOWN BY A STUDENT PILOT WHO HAD FAILED TO MAKE A POSITION REPORT........
....ARE YOU IN TROUBLE....PLEASE REPORT YOUR POSITION......CAN YOU HEAR ME ?
WHEN NO CONTACT COULD BE MADE A B-25 EQUIPPED WITH D/F HOMER WAS SENT TO LOCATE THE T-6..........
ONE AND ONE HALF HOURS AFTER MAKING HIS LAST POSITION REPORT, THE CADET CONTACTED THE LEAD SHIP.......
...T-6 TO LEADER..... I'M LOST !!
THE LEAD PILOT INSTRUCTED HIM...
.....MAINTAIN 110 MPH....USE MINIMUM CRUISE CONTROL.....USE RANGE RECEIVER ....WHEN YOUR ETA EXPIRES BEGIN TO CIRCLE...... MAINTAIN CONTACT .....OVER....
...THE COFFEE GRINDER HANDLE IS BROKEN...... DO SOMETHING...HELP ME..... HURRY!
CONTACT WAS MADE BY THE B-25.....THE STUDENT DID NOT FOLLOW INSTRUCTIONS AND BECAME, CONFUSED, SARCASTIC, AND PANICKY !
PICK UP A HEADING OF 140 DEGREES..... FLY A STEADY COURSE FOLLOW INSTRUCTIONS AND DO NOT CIRCLE.....
ARE YOU FLYING A CONSTANT HEADING ?
I SEE A LIGHT..... GOTTA GO SEE IF I CAN LAND....
NO! I'M SITTING ON A CLOUD PICKING MOONBEAMS !
HE WANDERED AIMLESSLY UNTIL —
I'M FLYING ON THE FUMES.... WHAT DO YOU WANT ME TO DO NOW—SIR—MAKE LIKE AN ANGEL ? HAW—HAW!
I'M BAILING OUT — .....HOPE THIS DOGGONE 'CHUTE WORKS...WELL IT SURE HAS BEEN NICE KNOWING YOU CHARACTERS..... ADIOS!
THE CHUTE WORKED O.K.
THE PRIMARY CAUSE OF THIS ACCIDENT WAS POOR JUDGMENT....THE CONFUSED STATE OF THE STUDENT AND HIS PERSONALITY CHANGE WAS BELIEVED TO HAVE BEEN CAUSED BY CARBON MONOXIDE POISONING...A BLOOD TEST TAKEN EIGHT HOURS AFTER THE ACCIDENT REVEALED A CARBON MONOXIDE SATURATION OF 15 PER CENT...DURING THE PERIOD OF GREATEST CONFUSION THE PER CENT OF SATURATION WAS CONSIDERABLY LARGER.....
...IN THE T-6 AND T-28 A GREATER AMOUNT OF CARBON MONOXIDE WAS PRESENT WHEN THE CANOPY WAS CRACKED THAN IN THE FULL OPEN OR FULL CLOSED POSITION...TO PREVENT CARBON MONOXIDE IN T-6 AIRCRAFT, CREW CHIEFS SHOULD COMPLY WITH TECH ORDER 1T-6C-6 REGARDING HEATER MUFF INSTALLATIONS...WHEN POSSIBLE 100 PER CENT OXYGEN SHOULD BE BREATHED WHEN CARBON MONOXIDE IS BELIEVED PRESENT !

CARBON MONOXIDE POISONING SYMPTOMS

Tightness across the forehead with slight headache. Headache with throbbing temples. Severe headache with dizziness, weakness, nausea, poor vision, vomiting and collapse.

# LIGHTNING



DURING 1953, the Directorate of Flight Safety Research received 25 reports of lightning damage to USAF aircraft. In all instances these planes were in flight when the strikes occurred. It is interesting to note that no injury to personnel was incurred.

Although this article is not intended primarily to pinpoint lighning damage, it is worth noting that in almost every reported incident the general pattern of strike damage was identical in all types of aircraft.

In fighter aircraft it appears that the Radome acts as a lighning rod and in cargo type planes the loop antenna appears to be very attractive to stray bolts of lightning. One other particularly vulnerable point on all types of aircraft is a wingtip.

Recently we received an incident report from Alaska that tends to bear out a theory we've been considering for quite some time. Let's see what you think of it.

The aircraft was flying at 7000 feet MSL on an IFR clearance. Terrain altitude varied from 500 to 2000 feet above sea level, and as far as the crew was concerned, this was strictly a routine flight.

At assigned altitude the gooney bird was for the most part on top of a cloud layer, but occasionally the pilot found it necessary to fly through towering cumulus clouds that were building up in the area.

The pilot estimated the tops to be about 12,000 feet but inasmuch as the plane was running through each one in short order, he thought it unnecessary to alter course or request an altitude change.

At a point where the terrain was approximately 2000 feet, the aircraft was struck by lightning. The plane was traveling through a fairly high cumulus cloud and the trailing antennae was extended at the time of the strike.

The antennae acted as a conductor for the bolt which went steaming up through the plane, knocked the liaison radio set out of commission and finally discharged through the tail cone.

Damage was confined to the trailing wire antennae and liaison radio set, and a small hole was burned in the tail cone. Now, here's the gimmick of this story. The aircraft's magnetic compass was found to be as much as 30 degrees off on some headings after the lightning strike.

Peculiarly enough, among the strikes reported through 1953 this was the only one where lightning went galloping up the trailing antennae, and there only two organizations reported magnetic compass problems as a result of lightning damage.

However, it cannot be assumed that these two lightning strikes were the only ones to affect magnetic compasses. On the contrary, it can be safely assumed that in every instance some magnetic disturbance resulted.

Considering how easily the magnets in a compass can be thrown off, let's ponder on the possibilities in the following incident:

An F-94B was on a routine proficiency flight over the sea of Japan. Altitude was 22,000 feet when the crew started to encounter thunderstorm activity. These storms were in all stages . . . cumulus clouds developing, genuinely mature and dissipating. The thunderstorms were surrounded by cirro-stratus type clouds, all of which extended to about 35,000 feet.

At first moderate turbulence was encountered. Then without warning the plane was struck by a bolt of lightning. It hit the nose of the aircraft with a blinding flash that was clearly discernable to both pilot and radar observer. A smoky odor was noticed in the cockpit but no actual smoke could be seen.

The pilot immediately cranked around in a 180-degree turn (still the best maneuver in the business). Within the next five minutes the plane was struck at least two more times. The bolts hit somewhere on the wings, ran all over the aircraft and were discharged at the external tank tips.

There was heavy precipitation in the form of rain when these strikes were incurred. Neither hail, ice nor St. Elmo's fire was encountered; but apparently this does not prove too much, for many lightning strikes have been reported when no precipitation was present.

About the time the F-94 received the last wallop from nature, the artificial horizon started to precess to the right and the pilot had to resort to partial panel flying until the plane broke out into the clear momentarily. In between cloud build-ups he cut in the spare inverter, the instrument was recaged, and it then started to function normally.

The airborne radar was at first reported inoperative by the radar observer but about 10 minutes later it started doing business again and they finally got the plane back home.

A postflight check revealed that the radar dome had a six-inch hole, the trailing cone of the left tiptank had been punctured and the servo tab for the left elevator had fused spots all over it.

Although not specifically mentioned, we'll take a few bets that the magnetic compass was really off after this little caper. There was enough voltage sizzling through the '94 to upset the best of magnets!

Here's another one to consider:

A senior pilot was wheeling along over the rolling hills of Indiana in a B-26 just about a year ago. The pilot was working his way through a cold front when he tangled with a bit of lightning. He was quite surprised, for it was snowing heavily at the time, and the free-air temperature was registering in the neighborhood of 15 degrees plus. It shouldn't have happened, but it did.

There were two flashes of lightning. The first was off the right wing and apparently did no damage. The second flash, or bolt, struck the lower left gun barrel sleeve and completely disintegrated the barrel cover. Next, it jumped into the cockpit and danced around long enough to render the radio compass inoperative (except on 'ANT'), and finally it slammed into the magnetic compass which promptly spun like a dervish and thereafter was 25 degrees in error.

Of course there's one thing about a lightning strike. You don't have time to duck. It's about on par with diving into a slit-trench after you hear some gunfire!

In still another incident an SA-16 started playing footsie with a typical Pacific typhoon. Needless to say, this wasn't from choice. But, as all of us know, sometimes such deals become a "must" from necessity alone. In any event, after getting slammed around between Okinawa and Luzon, the crew was mighty relieved to break out into some VFR conditions which unfortunately didn't last long.

They had been in the clear only a short while when a cumulo-nimbus type cloud was encountered. Because it was dark at the time, its presence was noted only because of a single flash of lightning that occurred in front of the aircraft but not particularly close. In a matter of moments, however, they were in a real ripper of a storm.

As the aircraft proceeded closer to the center of the storm, St. Elmo's fire was noticed on the free air temperature gage and jumping out in front of the plane. Heavy rain was encountered at this time accompanied by a very rapid increase in the intensity of static electricity on and around the aircraft. The scanners reported very heavy St. Elmo's fire all around the plane, and at the same time personnel in the cockpit noticed the whole plexiglas nose was blue with static discharges.

At this moment there was a brilliant flash of light which seemed to come from all directions. The right scanner reported that it came from his side of the aircraft and the left scanner reported that it came from his side of the plane. The pilot was under the impression that it had struck the right wing, while the aircraft commander felt certain that the plane had suffered a lightning strike from the left side.

Falling back on the safest course of action, the pilot swung the SA-16 around in a 180-degree turn and scooted out of the area. Total damage was two badly scorched wing-tips.

We sincerely wonder what happened to the magnetic compass!

Getting away from all-metal aircraft for a moment, the Editor recalls a day, years ago, when he ran into a bit of a storm while flying an old cabin Waco equipped with floats. During the brief fiasco, while attempting to fly basic instruments, lightning got into the act and danced the plane all over the sky. Fortunately, it was all over in a few moments, and much to the relief of three passengers and the pilot the battered biplane broke out in the clear, none the worse for wear except for a completely crazy compass.

Ever try to swing a compass while the crate's on floats?

Consider the fact that relatively small metal objects can throw a compass off. Place a pair of sun glasses or a screwdriver near the case, and in many instances you'll observe the card starting to swing erratically. Imagine then the possibilities of sudden demagnetization when a bolt of lightning starts tickling the magnets of a compass.

A good wrinkle to file away for future reference involves careful planning before a possible thunderstorm area is entered. Set the gyro compass just before penetration, and remember that if the plane should receive a hit, the gyro will be fairly accurate even if the magnetic compass is knocked out of the picture. Even in a relatively rough show the gyro probably won't precess excessively and will give you a sort of a yardstick for checking the magnetic compass for induced error.

In winding up this little story we'd like to suggest that maintenance and operations officers give a bit of serious thought to this lightning strike problem. Sooner or later, one or more of your planes will get involved in just such situations as we have described. When that sort of thing happens, FLYING SAFETY strongly urges that you make certain the magnetic compass is swung before releasing the plane for flight again. It's mighty cheap insurance.

### To Play It Safe

- Avoid flight through cumulonimbus clouds, at levels where the temperature is between +15° and −10°F, for high potential gradients and consequently disruptive charges can be expected.
- Avoid flight in the immediate vicinity of cumulonimbus clouds, especially when they have given manifestations of thunderstorm activity. It is preferable to keep at least 2500 feet or more away from them.
- Avoid flight through moderate or heavy rain and/or snow, sleet, hail or ice crystals, especially at levels where the temperature is from 20° to 10°F, particularly if the precipitation is from cumuliform clouds.
- If the precipitation static and/or corona discharge (St. Elmo's fire) is moderate to severe, and there is evidence from the temperature, cloud, and precipitation conditions that the airplane is in a zone of strong potential gradient between oppositely charged regions, reduce speed.
- Then seek a lower level where temperatures above 40°F prevail, or leave the given cloud and precipitation conditions. The tendency for precipitation-static sounds to increase rapidly in intensity should be regarded as precursory signs that a discharge is imminent. ●

A variety of aircraft are flown by company pilots on test flights, making a comprehensive safety program necessary.

## Here is the way one manufacturer handles his flying program . . .

# the SAFE way

*Flying programs in the aviation industry often have much in common with USAF operations. The fine flying safety records compiled by various manufacturers reflect their interest and concern with flight safety. FLYING SAFETY Magazine takes a look at a typical example of how one company operates its flight safety program.*

★ ★ ★

TAKE a big operation, add complex aircraft, mix in many flying hours and you have a flying safety problem. The Aircraft Operations and Flight Test Division at Hughes Aircraft Company has this problem whipped.

Led by Colonel C. A. Shoop, ANG, this division has compiled the envious record of four years of flying without an accident. This record was made in spite of the fact that the unit operates many different types of aircraft under test conditions.

The mission of the pilots of the division is to test and prove the various electronics and radar equipment produced at the company. Each pilot must have a working knowledge of the many phases of radar engineering. After each flight he makes his report to and works closely with the project engineer or physicist who developed the equipment.

The safety record was made in the face of some difficult situations. Up until a year ago the aircraft were operated off a sod runway that at times more resembled a quagmire after a session with the infamous California liquid sunshine. Even now the new concrete strip does not have a taxiway and aircraft must taxi in the same area where others are landing and taking off.

The pilots, who are all ex-service flyers, stay current in two jets each, as well as the conventional aircraft. This of course makes for a proficiency problem as new or different types and models are being tested all the time. It is a matter of keeping on top of the workload, and diligent, conscientious work and practice by all individuals concerned. At present, F-94s, F-89s, F-86s, B-45s, B-25s, T-29s, C-47s and C-45s are used for the tests. In the offing are the -100 series of aircraft.

This calls for considerable technical skill and knowledge from the maintenance and engineering personnel as well as the pilots. To keep ahead of this problem, a plan was devised and is in operation. Representatives from the company sit in on the development of any new types of aircraft scheduled to appear for tests. For instance, people from the division are sitting in on the production of the F-102 which will come to the company for installation of electronics and radar equipment. Also, if a new model of an aircraft is scheduled to appear, personnel are sent to the respective company for thorough briefing on any new developments.

It is pretty hard to put a finger on any one thing that is the key to the success of this operation. However, if any one thing is the answer, it is probably the supervision of Colonel Shoop. For here is supervision at its best. He asserts that no matter how far advanced aircraft become in the missile stage, the pilot will always be a vital part of flying. What's more, not just as a pusher of buttons; for good flying technique, "the old seat-of-the pants," will always make the difference.

Though chief of the division, he

The old sod runway in use until last year...

is also an integral part of it. Shoop is a firm believer in staying close to the operation in order to understand better the problems which arise. He monitors most landings and takeoffs personally. In his office he has a radio receiver and can tune in on all transmissions of the aircraft. He is in direct contact with the tower and can relay messages to a pilot if the situation demands.

This, of course, is invaluable if any emergency should arise. Colonel Shoop's position can be compared to that of the squadron commander. He feels personally responsible for the safety of his men as well as the aircraft. Knowing the value of safety, he says, "The lack of accidents at Hughes for the past five years has accounted for the expeditious development and production of advanced electronics systems with a tremendous saving in dollars and manpower to the company and the military services."

There is an interesting sidelight on the last accident of the division. Colonel Shoop was in a Bravo-25 and when it came time to put the gear down, the nosegear failed to extend. All emergency procedures were tried to no avail. The decision was made to land and try to keep the nose up long enough for some people on the ground to hold the tail down. Colonel Shoop made an excellent landing but the tail-holders-to-be could not catch up with the aircraft. The landing was such a good one and the damage, under the circumstances, so little that the Colonel received a letter of commendation. If you've got to have an accident, that's the way to have it. However, these people don't believe you have to have any accidents. Since the B-25 incident they have had a spotless four years to prove it.

**...replaced by new 7000-ft. concrete runway.**

A weekly flying safety meeting is SOP. These meetings serve as a review of new procedures, a briefing on what is to come, a comparison of notes between pilots, an opportunity for any type of instruction thought necessary and many other pertinent features. This gathering is not a dreaded occurrence or a chance to catch up with some sleep. It is looked forward to as one other thing which will allow the pilot to do his job better and safer. Also, any time something hot comes up, special meetings are held. This unit has found, as have many others, that training films are invaluable for learning new techniques and certainly add to the flying safety meeting if up-to-date and apropos.

Not only do they follow the requirements of the Civil Aeronautics Administration, but the regulations and SOPs of the USAF as well. No marginal flights are attempted. If it looks unsafe, they just don't do it. Standard air traffic control procedures are used.

Of course, new equipment usually means new operating procedures. After extensive testing and proving these are written up by the division to insure that the using activity has thorough knowledge of the new system.

The people in the division from the mechanic to the chief are proud, and justly so, of their safety record. This is reflected in each effort and one can sense the confidence in each individual to do his job efficiently and safely. Colonel Shoop sums it up:

"The Aircraft Operations and Flight Test safety record at Hughes Aircraft is accounted for by a combination of factors. Personnel are selected carefully from competent military-trained and experienced people. Considerable attention is given to such things as personality, temperament and ability to work with others. The safety is due also to an efficient aircraft maintenance and inspection system.

"In the final analysis, the high safety record is the result of the methods employed in the conduct of our electronics flight test program, such as careful flight planning and precision flight patterns which are designed to obtain desired test results with the maximum allowable flight safety that can be obtained in any flight test operation." ●

CUT HERE FOR EMERGENCY RESCUE

**Supervisor of Safety**

*Col. Clarence A. Shoop, ANG, started flying in 1930 as a cadet at March Field. He joined the California Air National Guard in 1933 and was called to active duty prior to World War II. He took part in the experimental test flying of the P-38.*

*Colonel Shoop was one of the first pilots in this country to fly jet aircraft, flying the XP-59, first jet airplane to fly in the U. S., the XP-80 and many other experimental aircraft. He has 12 years of experience test flying many types of aircraft and equipment.*

*Serving overseas with the 55th Fighter Group, 8th Air Force, he took command of the 7th Photo Recon Group D-Day -1. His group flew many missions and was considered one of the top-ranking photo recon groups in the ETO.*

*On his return to the U. S., Colonel Shoop was assigned to the Command of the Muroc Flight Test Base where he was instrumental in the program of development for that base and the numerous projects undergoing tests there.*

*Colonel Shoop is presently the commanding officer of the 146th Fighter Wing, ANG, Van Nuys, California.*

### AN OLD WORKHORSE IS . . .

# Put out to Pasture

ONE of the real "old timers" of jet-powered flight, the XB-43, was retired from service recently at the Air Research and Development Command's Air Force Flight Test Center, Edwards AFB, California. The nation's first jet bomber will spend the rest of her days at the National Air Museum of the Smithsonian Institute.

When the Douglas XB-43 was delivered to the Air Force Flight Test Center in 1947, its unique feature was unknown. Designed as a light bomber, it was destined to a future in research leading to improvements in modern jet engines and related equipment. Its arrival and flight tests were greeted with the heraldry and acclaim that is due a "first" in aviation, as the XB-43 was the nation's first jet bomber.

The aircraft was put through a series of rigorous tests to determine its possibilities as a tactical bomber. It measured up to the contractor's estimated performance, and in many ways exceeded these expectations. However, further tests demonstrated that in certain characteristics the aircraft was unstable. The flights were brought to an end. The XB-43 became one of the many stepping stones in the road toward improved aircraft designs, a rejected airplane.

After its rejection, the XB-43 stepped into another role. Unlike the other experimental aircraft, the plane was not scrapped or salvaged for usable parts. It became a flying test stand for jet engines.

With the two engine mounts located in the fuselage behind the pilot's compartment, one standard J-35 engine was removed and replaced with a test engine. Takeoffs and landings were performed with both engines. However, during high altitude operations, the J-35 engine was shut off or throttled back and tests performed on the other engine. Or, while maintaining altitude on the J-35 engine, full time could be devoted to studying the characteristics of the test engine with its modifications.

The kick-off to these experiments occurred in 1948. They have since proved to be of great value in the design of engines now in use in such Air Force planes as the North American F-86, North American B-45, Boeing B-47 and the Martin B-51. These tests can be credited with saving the lives of many pilots as well as reducing the cost of experimental flights.

A few of the tests performed with the XB-43 are as follows:

- Determination of J-47 minimum safe lube oil flow. It was believed at one time that many of the engine failures were caused by the reduction in the flow of lube oil in the jet engine. A J-47 engine was installed in one of the XB-43's engine mounts. Several hours were spent on the ground running up the engine before it was taken into the air. The first tests started at 10,000 feet with the engine running at full power and with full oil flow. This altitude, power and oil flow were held for 30 minutes. The pilot then turned, gained more altitude, reduced the oil flow a fraction and held his position for another 30 minutes. These tests continued over a period of weeks until an altitude of 40,000 feet had been reached and the oil flow reduced below minimum. Several facts were proved during the three months these tests were performed. One of the major results was a recommendation to aircraft manufacturers on the future design of pressurized oil tanks. Further, safe limits for the oil flow were set. At no time did engine failures result during the operations.

- Another test involved the replacement of the normal electric starter with a small gas turbine compressor and air turbine starter. Extensive experiments resulted in the U. S. Navy's adoption of the new gas compressor for many of their turboprop aircraft. As in previous tests, extensive ground run-ups were made before the plane was taken to altitude for the experimental operations.

- Special regulators to facilitate the high altitude starting of the J-47 engine were tested. Since the XB-43 could perform safely on only one engine, this type of test could be performed without endangering the life of the pilot. Recommendations designed to improve the starting characteristics of jet engines were passed along to the contractors after many altitude restarts.

- Main engine regulators and emergency regulators were put through experimental flights. The tests resulted in modifications and design changes.
- Ignition tests and tests on different ignitor plugs resulted in proposed changes.
- Temperature limiting control tests were performed. These were designed to limit the engine to the maximum operating temperature and relieve the pilot of the adjustments he would have to make under some altitude conditions. This would enable the pilot to devote more time to actual flying in combat or while on a bombing mission. The tests proved that the controls were unsatisfactory. A new control has been designed and future tests have been planned.

**Crew members prepare to fly USAF's first jet bomber to the National Air Museum for retirement.**

It has been stated that the XB-43, long out of date as a combat type plane, was the "most flown" aircraft at the Air Force Flight Test Center. Since most of the aircraft at the Center are of experimental type, this claim is probably true. To date, 230 hours and 50 minutes of flying time have been logged. The bulk of this time has been devoted to experimental work, with the exception of about 20 hours when the aircraft was used during the filming of the motion picture "Jet Pilot."

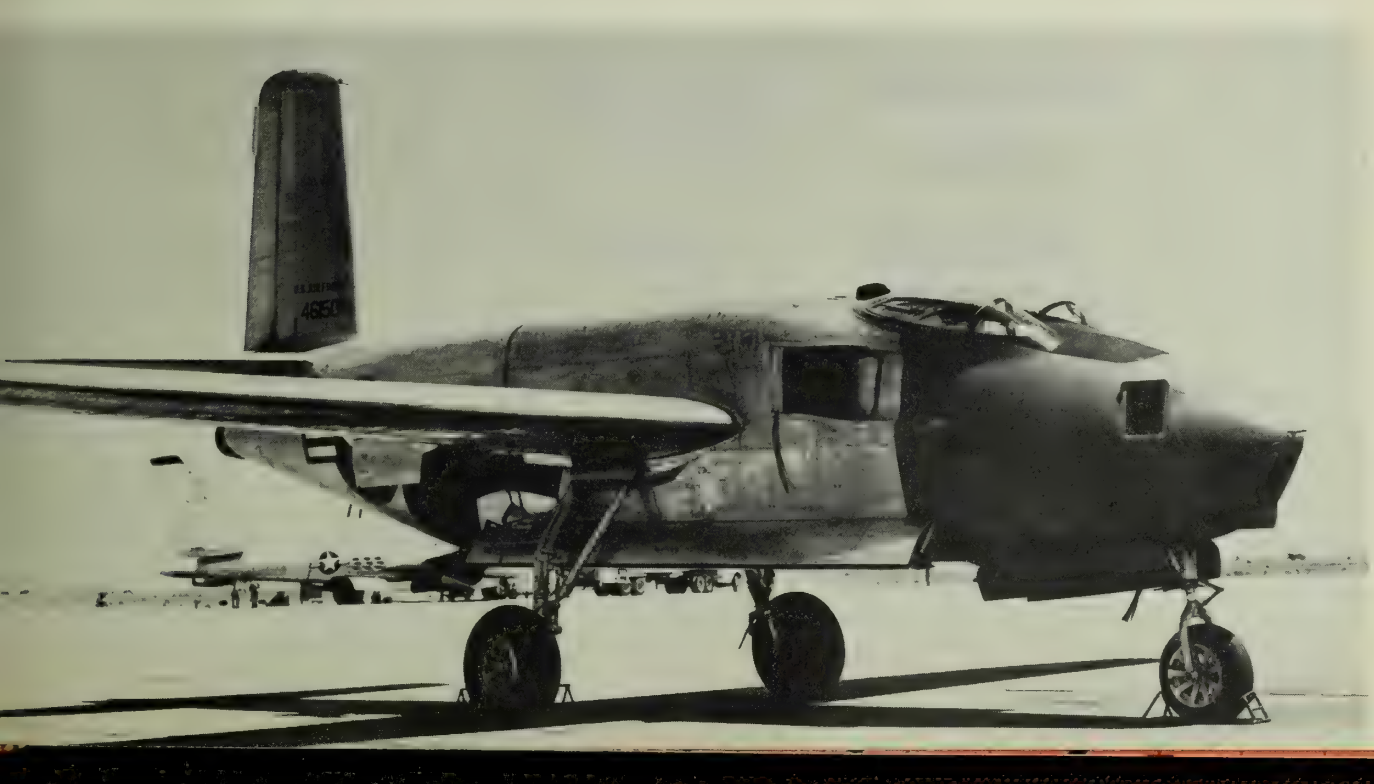
The majority of the experimental flights have been done by Major Arthur Murray and Captain James S. Nash, test pilots of the Air Force Flight Test Center.

Closely associated with the pilots in keeping the XB-43 in commission is M/Sgt Bernard A. Fahey. When parts were needed to perform necessary maintenance on the aircraft, it was Sergeant Fahey's responsibility as crew chief to obtain the replacements. Since the plane did not go into production and many of the parts required were not available through Douglas Aircraft Corporation or normal Air Force supply channels, the Sergeant was frequently required to handmake suitable substitutes.

The nickname of "Versatile II" has been assigned the XB-43. "The Frog" and "The Grasshopper" are other labels given the plane by the Edwards flight line mechanics. Living up to its official nickname, the XB-43 had a secondary responsibility as photographic plane. A specially designed nose section was installed, giving a photographer the advantage of shooting pictures from almost any desired angle.

The "X" will never be erased from the title of the XB-43, and it will never be "officially" counted among the U. S. Air Force aircraft, but Versatile II can look back on its history as a flying test stand at the AFFTC with pride. Aircraft engines and components tested in the XB-43 play an important part in the performance of "active duty" aircraft in today's (and tomorrow's) Air Force.●

**". . . the XB-43, long out of date as a combat type plane, was the 'most flown' aircraft at the Air Force Flight Test Center, Edwards AFB."**



# Keep Current

**Correct Radio Transmissions**—Incidents and accidents continue to occur because of unwarranted or misunderstood radio transmissions at crucial moments.

On one flight of two F-86s, during a normal takeoff, the wingman called the leader while rolling down the runway at 100 knots IAS, "Blank one, your left tiptank cap is loose." Blank one had a slight fuel siphoning condition. To Blank one (and the Mobile Control Officer) this statement was heard, "Blank one, your left tiptank is loose." Blank one aborted the takeoff, but could not stop the aircraft until it was off the end of the overrun of the 7350-foot runway. Although no damage was incurred, this type of incident could easily result in major damage to an aircraft.

In another incident, a radio transmission was correctly sent but incorrectly read by another member of the flight. This was a routine, formation flight of four F-86s. The flight leader thought he heard a transmission stating that he was on fire. He jettisoned his canopy and tried to eject. His seat mechanism failed and he rode the hot seat in successfully.

In reality the radio message had stated that the number three aircraft was on fire and this pilot ejected successfully. Granted the pilot should have checked for the fire more carefully, it is easy to see how this misunderstanding could have cost the USAF one each F-86.

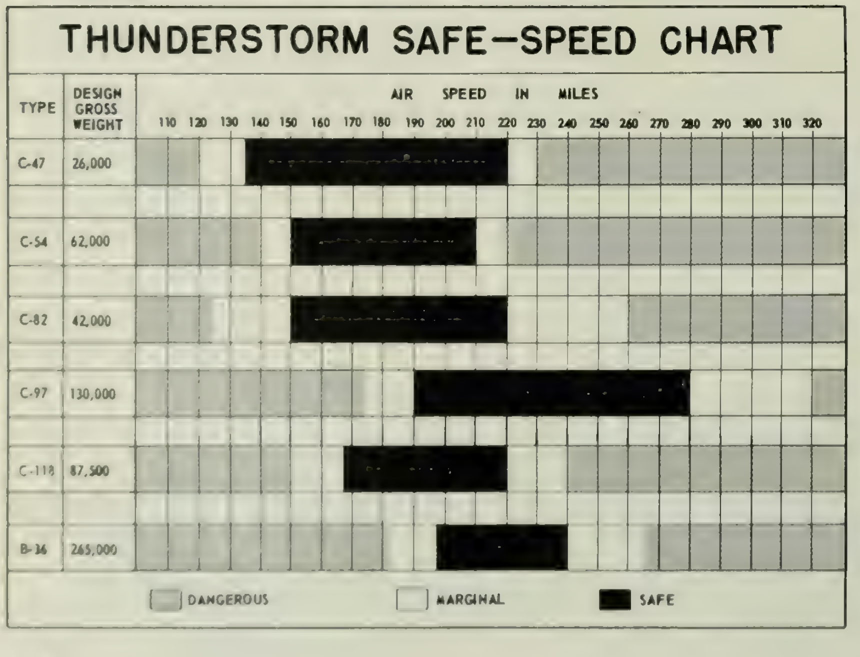
These are only two examples of incidents caused by careless transmissions. Who is to know how many accidents possibly could be attributed to it. Far be it for anyone to say that the radio is not a vital and important part of the aircraft and any flight. The problem is that the wrong word at the wrong time can make a harmless situation critical.

Use your radio, use it right . . . think before you speak.

★ ★ ★

**Planned Safety**—Basic concepts of flying safety were put into use recently during the successful movement of the 318th Fighter-Interceptor Squadron from McChord AFB, Washington, to Thule AFB, Greenland. The flight, involving F-94s and T-33s, required 24 days, 11 hops and 5477 miles for completion.

Chart shows dangerous, marginal and safe airspeeds for flight in areas of thunderstorm activity.



Needless to say, extensive flight planning was necessary for the operation. All flight plans were prepared, checked and filed until needed. Fuel consumption charts were compiled from technical orders and checked for accuracy by test flights. A complete set of maps was drawn up for each crew. The flight courses, proposed landing fields, with alternates, and emergency strips were studied by each crew member until all pertinent details were thoroughly familiar.

Each crew flew a training flight which duplicated in mileage the longest leg of the actual Arctic flight. An exact count of fuel consumption, oxygen requirements and aircraft performance was kept.

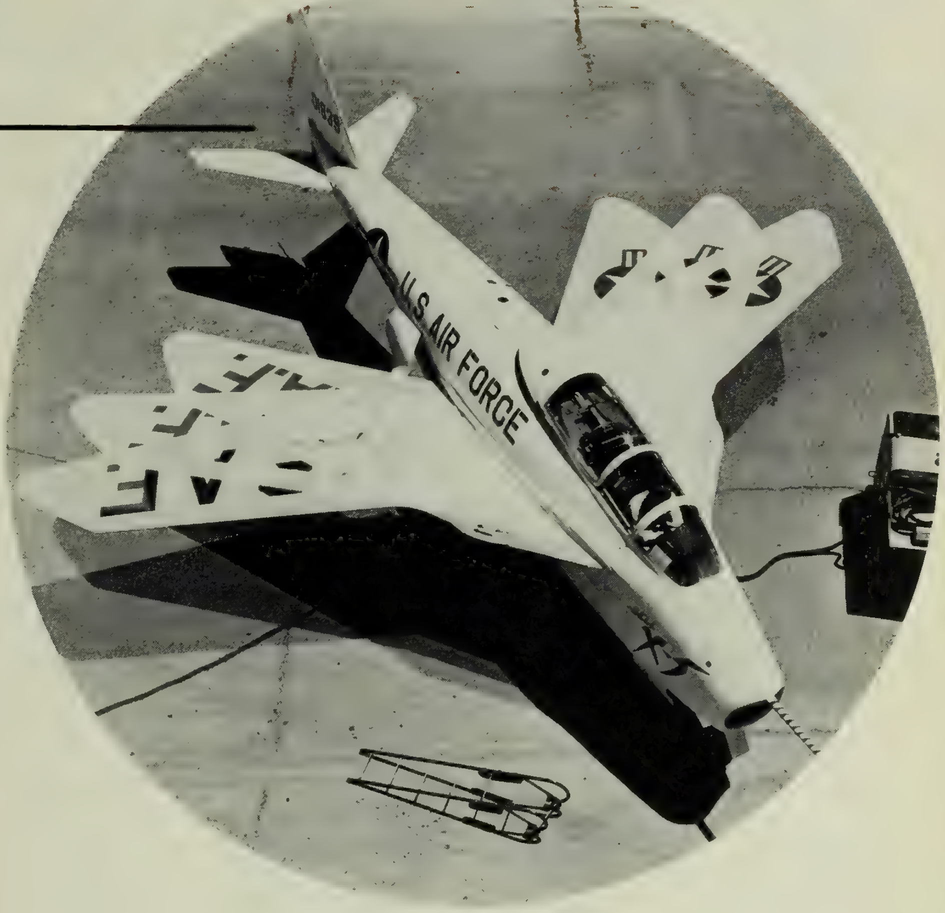
The first leg was 460 nautical miles from McChord to Great Falls, Montana. Before this flight and every flight, extensive briefings were held. All details of each phase of the flight were discussed and all emergency procedures covered.

Arrival at Great Falls was accomplished without incident and a short critique was held. This covered happenings along the way and the general condition of all the aircraft. The maintenance crew, who had accompanied the flight in two C-54s, then went over the aircraft.

Two incidents occurred during the subsequent three hops which took the flight to the Greater Pittsburgh Air Terminal. A float valve on one of the '94s stuck open on takeoff at Great Falls. By the time it was shaken loose, sufficient fuel had been lost to necessitate a landing. After refueling, the aircraft joined the squadron at the next stop. The second incident occurred when one of the '94s blew a tire on landing, but no damage was suffered.

On the leg from Dow AFB, Maine, to Harmon AFB, Newfoundland, water which had collected in the throttle linkage control boxes of several of the aircraft, froze at altitude. Therefore, one power setting had to be maintained throughout the flight.

An illustration of the variable wing sweep of the Bell X-5 which can be changed from 20 to 60 degrees while the aircraft is in flight.



All linkages thawed out upon descent, and the cause was eliminated by cutting a drain in the bottom of the control box.

There were no alternate landing fields from Goose Bay northward. Navigational aids were few and far between. Landmarks as checkpoints were not reliable to a group not familiar with the area. Homer beacons were provided by aircraft orbiting given points along the flight and transmitting a given wave signal.

The squadron was weathered in at Sondestrom AFB, Greenland, for a few days giving the maintenance personnel a chance to give the aircraft a thorough check. The final hop was to Thule and was the second longest of the flight. Although the weather cleared, headwinds were forecast which would run the F-94s close on fuel. As T-33s have a slightly longer cruising range, one was sent out to check the effects of the wind. The report back was favorable and the final leg to Thule was completed without a hitch.

There is nothing particularly phenomenal about this flight. However, it serves to illustrate a joint effort in accomplishing the mission and in flying safety.

★ ★ ★

**The Pressure Demand Oxygen Mask** — Question: When difficulty is experienced exhaling from a pressure demand oxygen mask, the probable source of trouble is:

a. The exhalation valve.
b. An inlet valve.

Recently this question was posed to a group of ten experienced pilots on a short oxygen equipment quiz. Only one of the ten knew the correct answer. And he alone knew how to correct such a difficulty.

Of course, the right answer to the question is choice (b). The exhalation difficulties with the pressure mask are in the inlet valves.

If at any time during exhalation the inlet valves do not provide a positive seal, breathing out will be very difficult. To simulate the lack of a positive seal, remove one of the inlet valves and try to exhale. Air may be blown out around the edge of the mask but not through the exhalation valve.

Several factors may prevent a positive inlet valve seal:

- If the rubber portion of the valve is warped, or if dirt is caught underneath, it won't seat properly.
- If the plastic base for the valve is not completely inserted in its receptacle, there can be no seal.
- On some small and medium masks, the microphone port may be pressed against the inlet valve structure and cause a leak between the rubber portion of the mask and the plastic base for the inlet valve.

Of these factors, the first is the most common and keeping the mask and particularly the inlet valves clean will eliminate most exhalation difficulties. Should an inlet valve become warped, it should be replaced. Of course, care must be taken to check for proper insertion of the inlet valve into the mask. In the third instance, however, the source of trouble may easily escape detection. Binding between the microphone port and the inlet valve has occurred primarily on small masks and occasionally on medium sizes. The remedy is to insert an additional rubber gasket around the plastic base of the inlet valve so that a tighter fit is provided between the mask proper and the inlet valve base.

It can be seen that if one of the inlet valves leaks or does not seat properly on exhalation, the force of exhalation is not only exerted on top of the exhalation valve, but is vented back through the inlet valve into the mask oxygen hose and then through the exhalation valve extension up to the underside of the exhalation valve. Consequently, with equal pressures present on both the top and bottom of this valve, the springs operate to keep the valve shut, and exhalation must take place by blowing the mask loose from the face.

Take the time to disassemble your mask and see how it works. When you have trouble exhaling, you should then have little difficulty locating the source of trouble.

# Totem Pole Climbers

**"Our aircraft accident rate can be lowered in 1954 if we make a concerted effort to continually seek out better preventive methods and daily emphasize flying safety."**

**General Curtis E. LeMay**

IF YOU land at a Strategic Air Command base one bright May morning and hang around a few hours, you're likely to find yourself thinking about checklists. A billboard outside Flight Operations will warn, "You might forget the checklist but the aircraft won't." The base newspaper you pick up in the coffee shop will catch your attention with a "Fly Safe" column – about checklists. Driving back to operations, maybe you'll pass a series of rhyming signs – selling checklists. Wandering down the hall to the weather forecaster's office, you might pass the monthly flying safety meeting in full swing – checklists again.

By this time, if you're a stranger around here, you'll probably decide that SAC has checklists on the mind this spring. But the crews of the Strategic Air Command know that all this is just part of the Safe Aircraft Campaign for '54. And that the primary topic for May is checklists.

When you visit this base in June and catch a sign

Nuts and bolts
Lying loose
Can blow a tire
And cook your goose.
Ramp clean?

you'll know that, before you're airborne again, you'll be exposed to a good many reminders about airdrome hazards, the prime subject for June. In July it will be takeoff and landing data cards, in August maintenance. And so on through the year.

This Safe Aircraft Campaign is designed to reduce SAC's aircraft accident rate for the fifth successive year. As carefully and elaborately worked out as a New York agency's plans to launch a new toothpaste, the Safe Aircraft Campaign for '54 is designed to sell just one thing — flying safety. Through a combination of "advertising," special awards and development of a competitive spirit among bases, SAC hopes to keep safety in flight uppermost in the mind of each individual in the command.

The campaign, and it has many ramifications, was organized by the Flying Safety Division at SAC headquarters, Offutt AFB. To see how it was being implemented down at wing level, *Flying Safety* paid a visit to the 320th Bombardment Wing at March Air Force Base.

The 320th's Flying Safety Officer is Captain Loyd A. Coats. A B-47 aircraft commander, Captain Coats has been Wing Flying Safety Officer for about 18 months. It's a full-time job. Here are some of the things that he and every other flying safety officer in the command are doing to make 1954 SAC's best safety year.

### Special Awards

In the command perhaps the most exclusive group as of the first of this year were the 16 crewmembers belonging to the Heads Up Flying Club. Organized by SAC in 1953, it is composed of flying personnel who averted an aircraft accident by an outstanding feat of airmanship or demonstration of judgment. When the flying safety officer knows of an individual he believes qualified for membership, he brings the facts to the attention of the commander, who in turn recommends the individual for membership in the club.

With membership goes a certificate of achievement from General Curtis E. LeMay, SAC Commander, a miniature model of the aircraft involved and a set of identification tags for flying clothes, proclaiming the wearer a "heads up" flyer.

At the time of our visit, the 320th Bomb Wing was preparing to recommend a captain of the 441st Bomb Squadron for membership. An observer on a B-47, the captain prevented an accident by his quick thinking. The aircraft was rolling down the runway for takeoff and had passed the unstick speed or point of no return when the bomb-bay doors fell open. Airspeed immediately dropped. Reacting instantly, he flicked the switch to close the doors. As soon as the drag was removed, airspeed began to increase again and the B-47 labored into the air to complete a successful takeoff. Had the observer hesitated a moment, had his attention wavered a few seconds from the warning lights, the bomber might well have crashed.

His name will be forwarded through channels of command to SAC headquarters, where his eligibility for the title of Heads Up crewmember will be determined.

Although Heads Up Flying Club nominations are made only when a special performance warrants it, every SAC organization is required to nominate a crew of the month (or pilot in the case of fighter organizations) and a maintenance man of the month from among its personnel. Nominations of the various organizations on a base compete to be the base's candidate when the contest reaches command level.

When *Flying Safety* visited the 320th Bomb Wing, they had just recommended a B-47 crew for the February award. These men had utilized their flying time so well and accomplished requirements of such high quality that they were declared combat ready one month ahead of schedule. On the wing simulated mission their run was better than the scored practice or record run of any other crew in the squadron, including combat ready crews. Their outstanding run had been made in spite of a tone malfunction and other difficulties. Should the crew become SAC's combat crew of the month, their picture and a story of their contribution to flying safety will appear in the command's magazine *Combat Crew*, and they will receive an achievement certificate from General LeMay.

The same awards are presented to the maintenance man of the month, who is chosen in a similar manner.

As the campaign guide points out, "The tremendous work accomplished day in and day out by maintenance crewmembers plays a vital part in the prevention of accidents. Any flying safety program failing to recognize this fact is only a flying safety program in part."

Typical of the 320th's nominees in the maintenance field is a staff sergeant of the 807th Operations Squadron, the wing's candidate for January. The C-45 this sergeant crews completed 50 hours of flight between periodic inspections without a single discrepancy.

When he was chosen as the wing's candidate for maintenance man of the month, his picture, together with a brief write-up of his qualifications, was posted on March AFB's three flying safety bulletin boards. This serves a double purpose: "advertising" for the safety program and an incentive to other maintenance men to equal or better the performance. Each month, the wing nominee at March receives a letter of appreciation from the base commander.

### Advertising

Advertising — keeping the "product" in everyone's mind — pays off. Realizing this, the Safe Aircraft Campaign calls for billboards, *Burma Shave*-type signs and other outdoor displays. The campaign manual offers the flying safety officer suggestions for his outdoor advertising. Around SAC bases this year, you'll see signs like:

You'll always be right
If you remember preflight.

and

The scanner said, "The flaps
are up."
The pilot said, "They're down."
St. Peter said, "You're welcome
boys,
But you should have gone
around!"

Brief and pointed, they get the message across. Perhaps better than ordinary written material.

In addition to displays like this, on every Strategic Air Command base you'll find a brightly painted totem pole which focuses attention on the command's year-long safety program. The names of the first four bases appearing on the totem pole are changed each month to reflect

current standings. It's every base's goal to be "high man on the totem pole." (Taking into account number of hours flown, an adjustment factor for the type aircraft operated and penalties for accidents, the bases are ranked each month and the base of the month given a permanent award in the form of a trophy. The base of the year also receives a trophy.)

Along with this outside "advertising" goes newspaper publicity. At March AFB, the *Beacon* carries a front page column on flying safety each month. Sometimes these are locally written, sometimes they are the monthly press releases issued by command headquarters. These columns tie in with the special theme for the month.

And along with newspaper publicity, some SAC bases have used radio programs with great success. For instance, Ramey AFB has used a weekly broadcast, "Rex Riley the Third." A flying hillbilly, whose job is saving Air Force dollars through accident prevention, narrates the program. People around Ramey might think Rex Riley III is pretty corny, but they listen to him. The program has been outstanding in instilling safety consciousness among Ramey personnel. Davis-Monthan, Ellsworth, Offutt and Forbes have all used radio successfully in their flying safety programs.

Although television is a more complicated media than radio, and audience-wise a more limited one, TV also has been used successfully in SAC's safety campaign. On five occasions, Flying Safety Division personnel have appeared on local and national television shows to discuss safety in flight. A network telecast also, of course, helps the civilian population understand that an intense safety program saves tax dollars.

### Other Campaign Devices

Flying safety meetings are familiar to all USAF flying personnel. At a SAC base attendance is mandatory at one squadron level meeting a month and one wing level meeting a month. The theme of the month is discussed at these meetings, as well as special local and seasonal problems. At March, Captain Coats attempts to keep his wing meetings lively by arranging for guest speakers and demonstrations by attached organizations such as the Air-Sea Rescue people. Articles from SAC's *Combat Crew*, *Flying Safety* magazine and the *Aircraft Accident* and *Maintenance Review* are used as material for flying safety meetings, as well as information brought to the flying safety officer's attention through the SAC incident report.

These incident reports are of considerable importance in the safety campaign. As one of the campaign slogans says, "Want to know about accidents? Ask the pilot who had one." But you can learn a lot, too, from the man who *almost* had one. From this idea was born the incident report.

Every aircrew member has experienced a near-accident, or he has had a complaint about some equipment or a procedure which he believes could cause an accident. By using the incident report he can tell his experience or make his complaint. In the Strategic Air Command these reports may be submitted anonymously if the individual desires. The report is submitted to the flying safety officer, who refers it for investigation, and also prepares copies which eventually wind up at every other base of the command. In this way, each base takes advantage of the experience of the others.

Once special awards and publicity have been taken care of, there remain the special local problems which affect safety of flight. These are handled at March AFB by the Flying Safety Committee, which meets monthly.

The committee is composed of commanders, principal staff officers and representatives of special organizations such as AACS and Installations. Each unit submits to the base flying safety officer topics or problems on which they wish action taken. The base flying safety officer has these matters investigated and chooses the most important for the agenda of the committee's monthly meeting.

When the committee convenes, it is able to deal with problems quickly since commanders are present and can immediately order appropriate staff officers to take necessary action or appoint a sub-committee to make further investigation. At the next monthly meeting, commanders go over the old business to insure that all problems have been dealt with and adequate action taken. March has found that through this committee local flying safety problems are dealt with quickly and efficiently.

By now, although this has been only an outline, you can see that the

Safe Aircraft Campaign for '54 is a big operation. Expensive to implement, you say? Not so expensive as just one major aircraft accident. Successful? The accident rates computed at the end of the year will answer that. But the command's steadily decreasing rate the last few years has proved the worth of past campaigns.

Flying safety is a reflection of high proficiency in all phases of flying. It is the measurable result of an attitude of mind shared by pilots, crewmembers and maintenance men alike. An attitude of mind that combines discipline with knowledge. The Strategic Air Command mission frequently involves the assuming of calculated risks. But good flying safety habits mean precision, efficiency and reliability. And those qualities enhance the prospects of a successful mission.●

spring

summer

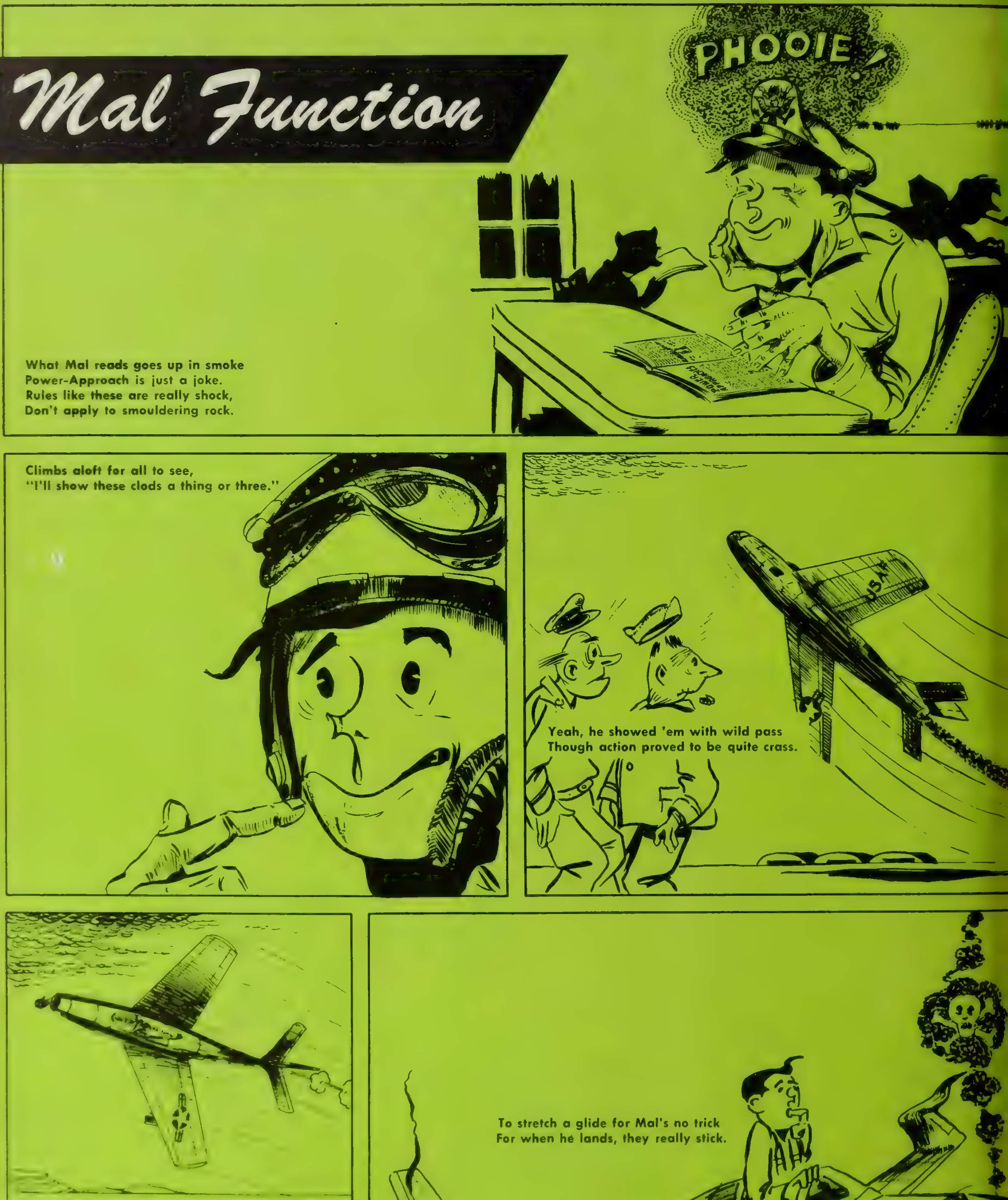
*Every season has its hazards and, as every flyboy knows, advance briefing always pays off. Early storm warnings are a must!*

See this month's centerspread for the first of a new series of seasonal flight hazards. The Directorate of Climatology, AWS, will keep you posted through the medium of FLYING SAFETY.

fall

winter

# Mal Function


PHOOIE!
What Mal reads goes up in smoke
Power-Approach is just a joke.
Rules like these are really shock,
Don't apply to smouldering rock.
Climbs aloft for all to see,
"I'll show these clods a thing or three."
USAF
Yeah, he showed 'em with wild pass
Though action proved to be quite crass.
World War zoom with throttle aft,
Not recommended for jet aircraft.
To stretch a glide for Mal's no trick
For when he lands, they really stick.

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MAY, 1954

# FLYING SAFETY

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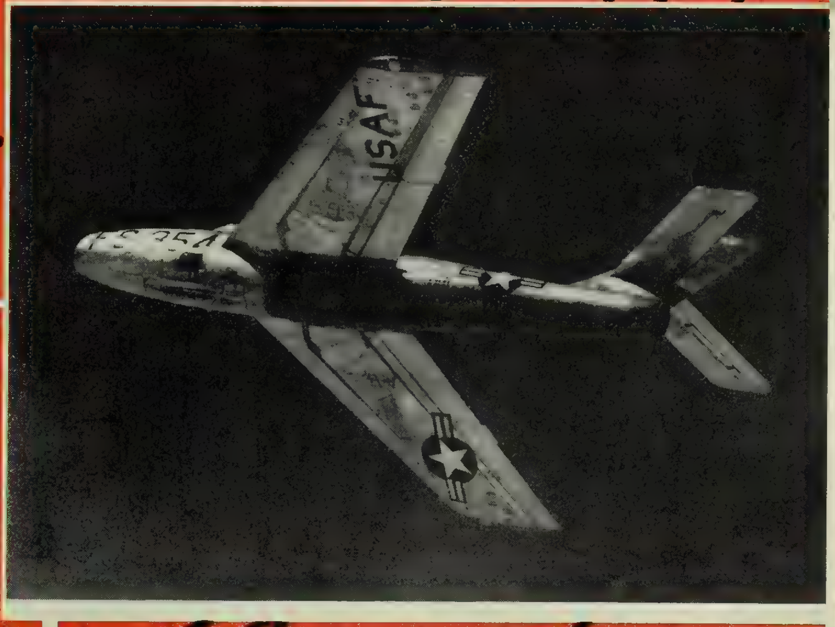

## YAW

... High Speed Flight Characteristics

# FLYING SAFETY

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Major Chuck Yeager glides the X-1A in for a landing after test flight. Story on page 14.

## SUBSCRIPTIONS

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★ ★ ★

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USAF PUBLICATION 62-1

# Yaw Law

*For many years, aircraft designers have toyed with the idea of introducing a true swept-wing design. As airspeeds have increased, so too have the problems that crop up near the sonic wall. Buffeting, aileron buzz, pitch-up and other allied ills have accompanied attempts to squeeze more speed from our aircraft. The logical question then was, will a swept-wing design solve some of these problems?*

*Some manufacturers firmly believed that maximum performance could be achieved with straight wing aircraft. Others were of the opinion that a swept-wing design was the answer. As a matter of fact, both schools of thought have merit.*

*As we have progressed further into this swept-wing business, certain flight characteristics have manifested themselves that bear careful consideration. One particularly undesirable trait evolves around stall tendencies when the aircraft yaws. This is more pronounced in some types than others, i.e., fighters vs. bombers and consequently the Directorate of Flight Safety Research decided that a definite study of this and other conditions was warranted.*

*Accordingly, a series of questions was submitted to the various aircraft manufacturers throughout the industry. In general the questions covered the following:*

☆ *In which maneuvers or attitudes are swept-wing aircraft exposed to loss of control because of difference in airflow over the swept-wing as compared to airflow over a straight wing?*

☆ *What are the effects on control when operating multi-engine swept-wing jets with engines inoperative on one side or with partial power on both sides?*

☆ *Is yawing the most significant or the only maneuver which should be avoided?*

☆ *What degree of yaw (or other maneuver) is considered dangerous in swept-wing aircraft?*

☆ *At what speeds is yawing considered dangerous on swept-wing aircraft?*

☆ *What corrective, preventive or precautionary action is recommended for safety?*

*This is the first of two articles dealing with the problem of straight-wing vs. swept-wing design as submitted by various manufacturers.*

**This is the first of two articles, written by aeronautical engineers, on problems facing designers in the swept-wing field.**

Republic, Northrop and Bell engineers prepared this article.

**By A. Kartveli, Vice President-Chief Engineer**

***Republic Aviation Corporation***

In reply to *Flying Safety Magazine's* request for an article on swept-wing flight characteristics, the following comments are submitted. The questions as listed are taken up in turn.

- In which maneuvers or attitudes are sweptback wing aircraft exposed to loss of control because of the difference in airflow over the swept-wing as compared to airflow over a straight wing?

Probably the most important maneuver that is of importance to the pilot is symmetrical pitch. Many of the current swept-wing aircraft have a pitch-up problem that is the direct result of a swept-wing configuration.

Swept wings, in general, lose their lift first on the tip sections at high angles of attack or from shock-induced separation at high speeds. Thus, as the wing lift concentrates inboard, it moves forward on the wing panel, causing the airplane to pitch up. The resulting changes in downwash flow from the wing to a horizontal tail placed above the wing chord plane further increase this pitch-up effect.

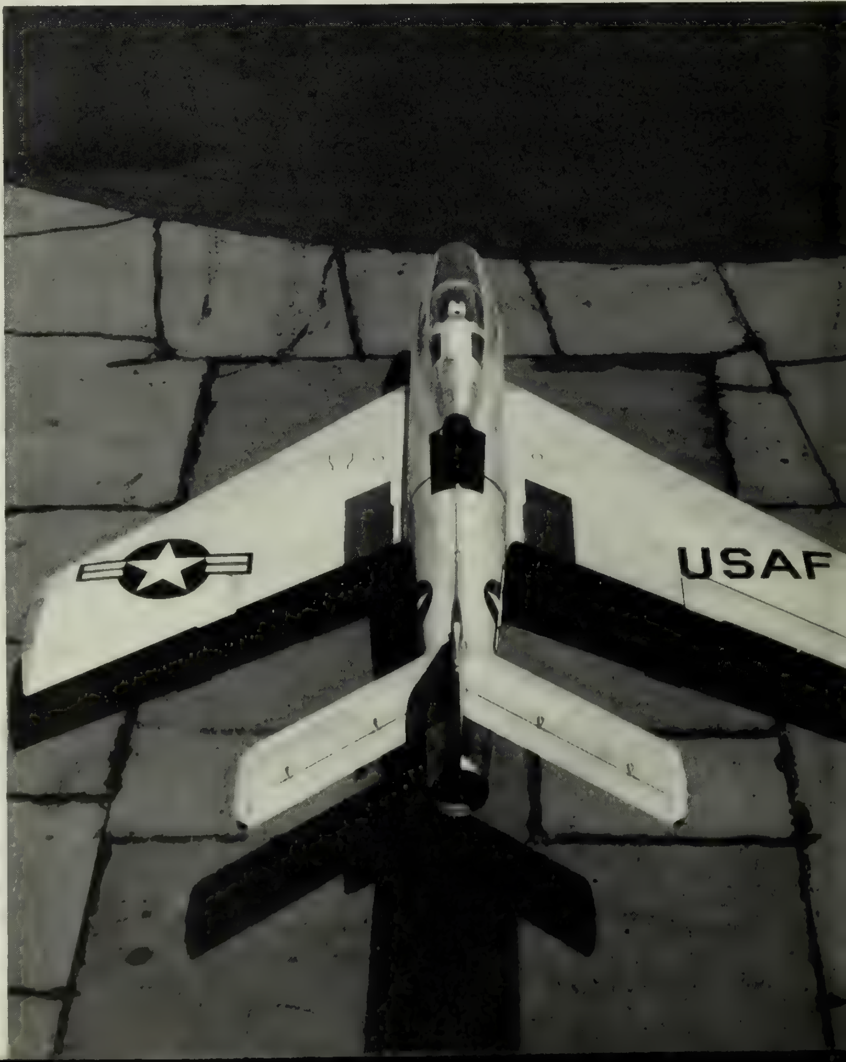
Many types of fixes, such as wing fences or slats, are used today to alleviate or cure this problem. A number of them work well at low speeds during landing and takeoff, but do little to fix the high speed pitch-up problem. Current design practice indicates that locating the horizontal tail below the wing chord plane will cure the problem. The wing pitch-up is compensated by a favorable pitch-down moment from the horizontal tail. Practically all of the latest fighters being designed by all companies will have this favorable tail location. Until the time when these planes are in use, the amount and regions of pitch-up should be investigated cautiously by all pilots, as it will vary between different designs and amount of fixes used.

Pitch-up is not a loss in control problem but rather a change in stability or trim change. The longitudinal control system, elevator or all-movable tail, does not lose effectiveness during pitch-up. If the pilot anticipates and uses his control system correctly, he can control it.

As stated above, flow separation inherently starts at the wingtips of a sweptback airplane. Thus, conventional ailerons located in these regions will lose effectiveness at lower wing lift coefficients than those on a straight wing aircraft. Therefore, this effect should be carefully investigated by each pilot in a swept-wing aircraft. By landing faster and by avoiding extremely high lift coefficients in clean flight, he can avoid most of these difficulties.

At normal angles of attack, the control surfaces of swept-wing airplanes lose less effectiveness with the same increase in Mach number or dynamic pressure than do straight-wing control surfaces. Since swept-wing airplanes are capable of much higher airspeeds, it is a popular misconception that loss of controllability is greater for swept airplanes at low and moderate angles of attack.

- What are the effects on control when operating multi-engine swept-wing jets with engines inoperative on one side of the fuselage only, or



with partial power on one or each side?

This question is not applicable to any of Republic's airplanes, and will not be discussed.

• Is yawing the most significant or the only maneuver which should be avoided?

Yawing is not particularly significant or necessarily to be avoided if the pilot knows his airplane's limits and characteristics. Crosswind landings and takeoffs are about the only times yaw, or rather sideslip, is required of modern swept-back airplanes. At these times, yaw cannot be avoided but must be controlled.

• What degree of yaw (or other maneuver) is considered dangerous on swept-wing aircraft?

Any degree of yaw, pitch or roll that cannot be controlled by the normal use of the control surfaces is considered dangerous. The degree varies widely between various swept-wing designs and again must be explored for each particular airplane. Swept wings have much more roll due to yaw at high lift coefficients (low speeds) than do straight wings. A certain amount of roll due to yaw is desirable. By proper design of negative rather than positive wing dihedral on a swept-wing airplane, the excessive roll due to yaw may be reduced. However, negative dihedral must be used with discretion in order to avoid a destabilizing roll due to yaw at high speeds.

• At what airspeeds is yawing considered dangerous on swept-wing aircraft?

As previously stated, takeoffs and landings are the only maneuvers that require yaw. It is at these higher lift coefficients that swept-wing roll due to yaw is greatest and aileron effectiveness possibly reduced. Therefore, swept-wing fighters cannot be landed at the same speed in as great a crosswind as can straight wing airplanes, unless the design practices indicated below are followed.

• What corrective, preventive or precautionary action is recommended for safety?

Because a swept-wing airplane cannot inherently attain as high lift coefficients as a straight wing airplane, takeoffs and landings will be at somewhat greater speeds. The greater forward speeds reduce the crosswind angles to help the situation. Furthermore, larger and more effective ailerons and the negative dihedral used in correctly designed swept airplanes relieve the situation.

If the pilot has a powerful rudder that is capable of skidding the airplane to large yaw angles, he must be careful near the ground not to exceed an angle at which he can hold the wings level with the ailerons. Conversely this can be helpful if the rudder is used correctly. That is, the rudder at low speeds is very powerful in raising a low wing.

At low speeds, dynamic lateral stability may be somewhat worse than on straight-wing aircraft. Also, because of the trend toward high fuselage inertia and flight at high altitudes, a dynamic lateral stability problem may occur in cruise flight. Usually this problem is classed as annoying to the pilot and reduces the effectiveness of the plane as a steady gun platform.

Normally it is not classed as dangerous, as this "dutch" rolling tendency doesn't diverge. The pilot, by corrective control action, can usually stop the motion and in cases where he cannot, an automatic yaw damper is used in the design. ●

**By Wm. F. Ballhaus**
**Chief Engineer**
***Northrop Aircraft, Inc.***

The chief handling quality problems that arise because of wing sweep-back are:

- The tendency of the airplane to pitch up abruptly at high angles of attack.
- A decrease in aileron effectiveness at high angles of attack.
- A large increase in dihedral effect at high angles of attack.

The pitch-up tendency and the poor aileron effectiveness of swept-wings are caused by the outward spanwise flow of low-velocity air near the surface of the wing, an effect which increases in magnitude as the angle of attack of the airplane is increased. In the case of pitch-up, this low-energy flow tends to separate from the upper surface of the wing near the tips, rendering the tip portions of the wing ineffective compared to the apex portion, and resulting in an abrupt nose-up pitching moment.

If conventional trailing-edge type ailerons are located in this low-energy spanwise flow region, it can be seen that the aileron effectiveness will tend to decrease as the angle of attack of the airplane is increased, because of the increased severity of the spanwise flow with increasing angle of attack.

A swept-wing inherently shows positive dihedral effect even if the amount of "built in" dihedral is zero. A simple explanation of this is shown in Figure 1.

When the airplane is sideslipping to the right as shown, the relative wind strikes the left wing panel very obliquely compared to the right wing panel.

Because of this asymmetry, the lift on the right wing panel is much greater than that on the left panel, thus creating a very large rolling moment to the left. It has been found that the magnitude of this rolling moment increases with an increase in angle of attack of the airplane.

A further consideration in the handling qualities of swept-wing aircraft is the effect of aspect ratio. In general, the higher the aspect ratio the more pronounced are the detrimental effects of sweep, because the spanwise flow effects are accentuated. On the other hand, highly swept-wing aircraft of very low aspect ratio introduce a directional instability problem caused by the severe sideflow effects on the aft portion of the wing and on the vertical tail. The directional instability of this particular type of airplane occurs only at very high angles of attack, and may or may not be readily controllable by use of the rudder control by the pilot, depending on how fast the rate of divergence becomes.

Specific answers to enumerated questions presented by a representative of the D/FSR on his visit to Northrop, 15 February 1954, are as follows:

- Maneuvers which may result in loss of control of swept-wing aircraft can be separated into two types: those involving the abrupt longitudinal pitch-up, and those in which sideslipping occurs when the airplane is at a high angle of attack.

The abrupt pitch-up tendency occurs during high G dive recoveries and high G turns. It is especially dangerous because a pilot's reaction time may be too slow to apply corrective elevator motion before a destructive G load has been imposed on the airplane structure.

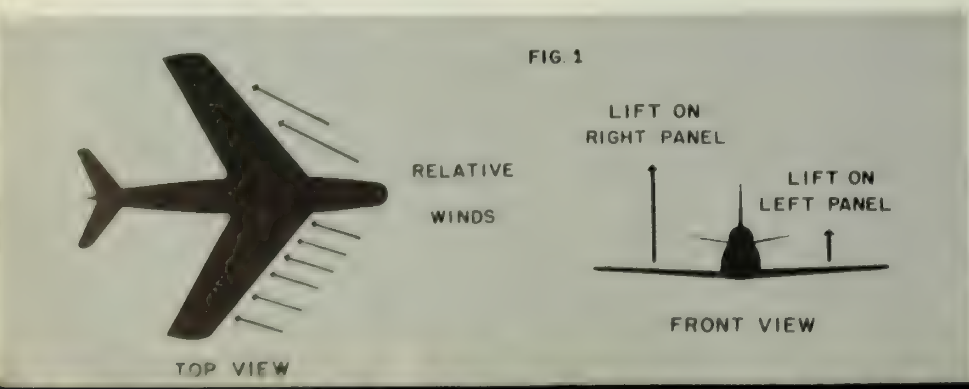
Examples of the second type of dangerous maneuvers are intentional sideslipping in the landing approach, and sideslipping when pulling high G normal acceleration. These maneuvers are hazardous because the sideslip creates a large rolling moment (due to the high effective dihedral of the swept wing) which requires considerable aileron deflection to balance out, and leaves little additional aileron motion for margin of safety.

- On multi-engine swept-wing aircraft, the loss of an engine on one side may or may not result in a serious control problem depending on the particular design and the pilot technique involved. If the sideslip angle is allowed to become too large, the pilot may have insufficient aileron control to prevent the airplane from rolling, as explained above.
- The abrupt pitch-up tendency in high G maneuvers is probably the most dangerous characteristic of the swept-wing airplane as far as pilot-aircraft safety is concerned. The sideslipping maneuver can also be very significant in this respect, because of the possible loss of lateral control at low altitudes, say, during a landing approach.
- The permissible degree of sideslip as far as flying safety is concerned would vary within large limits for each particular airplane. An arbitrary scale for *intentional* sideslips would perhaps be defined as follows: five degrees maximum sideslip when in the landing approach; 10 degrees maximum for any maneuvers at high angles of attack, and 15 degrees absolute maximum under any condition.
- Based on the above discussion, it is indicated that sideslip maneuvers would be more critical at low *indicated* airspeeds because of the associated high angles of attack.
- Recommended preventive or precautionary action:

With regard to the pitch-up tendency of swept-wing aircraft, it should be expected that the manufacturer provide sufficient alleviation, either in the form of aerodynamic fixes, control force or control deflection G limiters, to prevent the pilot from inadvertently overstressing the airplane. Pilot indoctrination and training in this particular handling characteristic is, of course, an important aid here, but may prove to be inadequate for some aircraft designs.

With regard to sideslipping, the precautionary action is for the pilot to avoid large sideslipping maneuvers in swept-wing airplanes. ●

FIG. 1



**By S. W. Smith, Chief Airplane Engineer**
***Bell Aircraft Corporation***

Changing the aerodynamic properties of aircraft by incorporating wing sweepback has resulted in differences in flight characteristics between swept and straight winged designs.

In addition, many of the general problems of high speed flight have been attributed to swept-wing planforms because they have been discovered and are continually encountered by operational swept-wing aircraft. While certain flight characteristics are caused by wing sweepback, for the most part sweepback is just one of many factors that may alleviate or aggravate the existing flight characteristics of a specific design.

The performance advantage of swept-wing design lies primarily in delaying the flight Mach number at which the drag rise occurs by reducing the effective Mach number, which is roughly perpendicular to the wing leading-edge. Furthermore, sweep causes a more gradual increase of drag rise and reduces the zero lift drag below that for straight wings. This latter drag effect is somewhat offset by an increase in drag because of lift.

The same geometrical characteristics that reduce the effective Mach number reduce the amount of lift obtained with a given angle of attack, thereby requiring higher angles to support a given lift or weight for swept than straight wings. An example of this is the high attitude angles required when landing highly swept aircraft.

One consequence of sweepback is that the wing tips carry a larger proportion of lift than do straight wings. Sweepback also generates a spanwise flow in the boundary layer which causes undesirable thickening of the boundary layer as it flows toward the tips. This promotes early flow separation at the wing tips with attendant loss of lift. The center of pressure, therefore, moves inboard along the quarter chord, which is a forward movement for a swept wing. This forward motion of the main lifting force causes a noseup motion known as pitch-up. An added difficulty arises when the tip stall does not occur symmetrically, resulting in unbalanced lifts and drags that cause corresponding rolls and yaws.

Recovery from the pitch-up depends upon rapid reversal of the control surface. However, just as sweep decreases the lift variation with angle of attack of the wing, sweep decreases the lifting or controlling capacity of a control surface with deflection. Hence sweptback control surfaces require more deflection for a given maneuver that do straight surfaces.

Many things can be done to relieve the effects of tip stall such as washout, camber, fences, chord-extensions and varying airfoil section. It may also be observed that effectiveness of control surfaces will vary with location and trailing edge contour. It should be apparent that no generalizations can be made about sweptback aircraft to the amount of pitch-up to be expected, when it will occur, or the amount of control deflection that will be required to control it.

As Mach number becomes transonic, changes occur in the flow characteristics over an aircraft which cause an aft movement of the center of lift, a reduction in the effectiveness of the control surfaces, shock waves and changes in many separate aerodynamic items that combine to change the overall flying qualities.

Two transonic effects that accentuate the effect of pitch-up and increase the amount of control necessary for a desired maneuver are the rearward movement in the center of pressure from the quarter to half chord thereby making the airplane more stable and the diminishing of control effectiveness. Each item requires the use of more surface deflection transonically and supersonically than subsonically. Center of pressure shift also causes longitudinal trim changes when traversing transonic Mach number region.

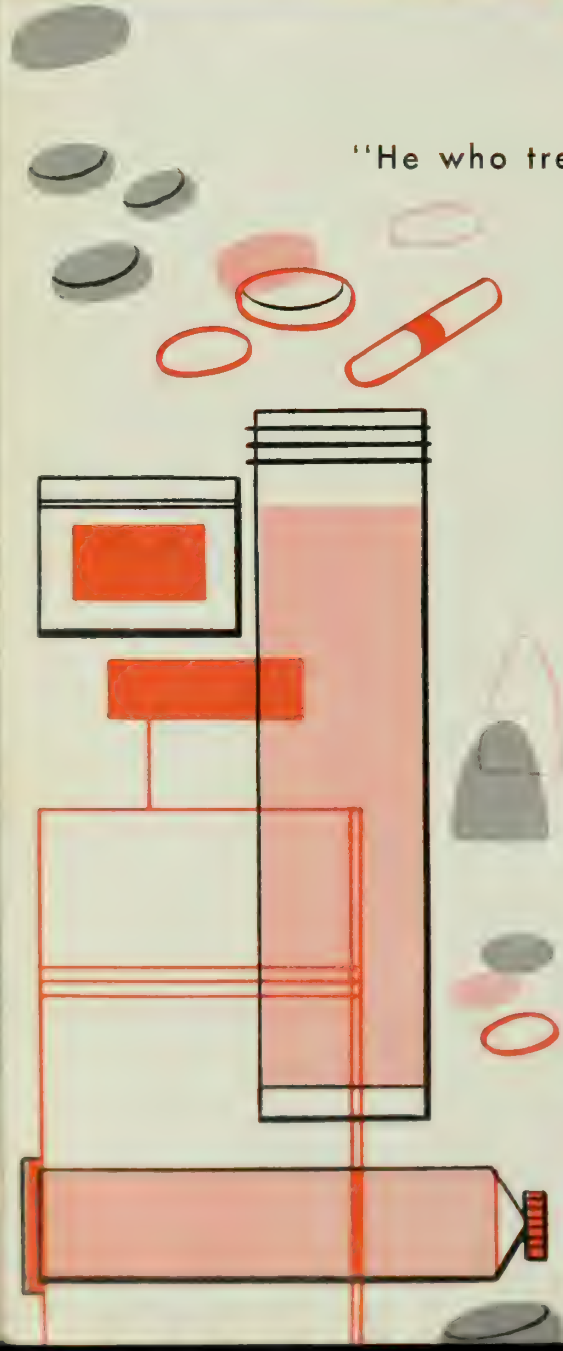
Many aerodynamic characteristics are interrelated in their effect upon an aircraft's flying qualities. Such aerodynamic items as dihedral effect and weathercock stability which are largely affected by sweepback, are as much influenced by factors such as aspect ratio, area, location, thickness and taper. Since many aerodynamic items must be combined to determine matters of as much significance in flying the airplane as lateral and longitudinal dynamic stability, it is an unwarranted oversimplification to attribute these resulting aircraft motions to the degree of sweepback.

Other problems of high speed flight are those of wing heaviness and of buffet at low lift, both of which are related to shock waves on lifting surfaces and subsequent flow separation. When the shocks on each wing are not symmetric as might be caused by a yaw angle or a wing rigging asymmetry, the separation will be greater on one wing, thereby requiring aileron to hold up the wing. The separated flow will cause a buffet whenever its frequency corresponds to a natural frequency of a structural member in the flow field. The effect of sweepback both softens the shock effects and reduces the Mach number range of its occurrence by delaying the onset Mach number while having little effect on the terminating Mach number of about one, when the shock moves to the trailing edge.

Most of the above high speed characteristics cannot be categorized solely by the degree of sweepback of the wings, since they are characteristics of specific aircraft that include other design features that have equal importance with sweepback in determination of the overall flying qualities. Only those phenomena associated with spanwise flow can be attributed directly to sweepback. ●

# Fit to Fly

"He who treats himself has a fool for a doctor."



**By H. G. Moseley • Colonel USAF (MC)**
**Chief, Medical Safety Division**
**Directorate of Flight Safety Research**

*This month we are presenting two examples of individuals who were involved in aircraft accidents. One was fatal. Both of these cases are true. We believe that they represent food for thought.*

★ ★ ★

IT WAS a clear morning. The kind of a day that makes you want to fly. The sky was blue and the surface wind was little more than a warm breeze. A wonderful day to be alive.

The captain was being very careful with his flight planning. He cross-checked the strip map against the latest Radio Facility Chart. Ranges were changing rapidly these days and he had discovered early in his career that one could never depend entirely on a map.

Then he examined the NOTAM file. Nothing to worry about. One en route air base reported construction on runway two-four and six. One range was carried as unreliable. No sweat today. This would be VFR anyway.

He carried the form 175 into weather. The forecaster was busy getting a C-124 crew squared away so the captain studied the winds aloft charts and mentally selected an altitude that looked favorable. In a few moments the forecaster was finished with the Globemaster pilots and turned his attention to the captain. This was an easy clearance. A very few thin scattered alto-cumulus at 20,000 and nothing else. Scrawling his signature on the forecast, the weather officer said, "Good Luck. See you later." and turned to the next crew.

The captain spent another couple of minutes rechecking his flight plan. Everything appeared okay. He had no doubts as to his personal ability as a pilot but he did have a healthy respect for his aircraft and this T-33 was not forgiving of poor flight planning as a conventional aircraft with large fuel reserves.

Picking up the carbon copy of the clearance, the captain walked out to his plane. Again he checked carefully. The machine was clean. The crew chief walked with him as he made the preflight walk-around.

"Everything looks okay," he said to the sergeant.

"She's a good one," replied the crew chief as he helped the captain adjust his parachute.

The sergeant said "she" subconsciously as men have always said "she" when they spoke of fine ships. And she was a good plane, down to every flush rivet, down to the strength and precision of every stringer and former. She should be good; thousands upon thousands of manhours had gone into her perfection and now for hundreds of hours she had carried her pilots safely and comfortably from one end of the country to the other.

This morning she was ready for another mission. That this was to be her last flight was not her fault. The captain had wilfully ignored one vital check. As a result, both he and "she" were destroyed. One moment they were cruising straight and serene. Then they entered a gradually steepening dive to the earth. There was never a change of power setting; not even the simplest attempt to alter the tragic course. Human control had lapsed.

To understand this strange case one must go back a year or two. That was when the captain first noticed that something was wrong. It was evening and he was sitting down reading the paper when it happened. If he had been asked to explain what was wrong, he probably would have said he felt something turning over in his chest and that he felt a slight choking sensation. After a few moments it was over, completely gone. Outside of a bit of perspiration on his brow he was perfectly normal. He did not think anything more of it. Not just then anyway.

However, as time went on he began to have additional attacks of this strange sensation in his chest and twice in recent months he had blacked out completely for a few moments when these spells came. He was afraid that one might happen some day when he was driving. He may have been afraid to think what might happen if he had a spell while flying. Unfortunately he found out. It was too late then.

What is inexplicable is that he never went to his flight surgeon. Even on his annual physical examination he denied any trouble or abnormal physical condition. It may be that he thought his trouble insignificant. It is more probable that he was afraid the doctor would ground him. And that is what would have happened in this case.

The flight surgeon would have told him that he had trouble with his heart, and probably given it some name such as "paroxysmal tachycardia." How long this man would have been grounded we do not know. Perhaps permanently. Certainly until the cause could have been found and eliminated. One thing is certain, the flight surgeon would have saved his life.

Fortunately, there are only a few pilots who delude themselves into thinking they can fly while seriously ill or while suffering from an unpredictable physical hazard. However, between serious or hazardous illness and good health, there are a variety of conditions and a multitude of strange cases.

For our second example we have selected a true story of a lieutenant with a headache.

This case took place in one of our southwestern states and in the winter. The lieutenant, who was a new arrival at the base, was living in an off-base cottage of dubious elegance but which did suffice as a temporary shelter for the officer and his family.

The weather was cold and for several days it had been necessary to keep the windows closed and an open gas heater burning both day and night.

For several mornings the lieutenant had noticed a headache when he arose. It was a rather nasty headache associated with some dizziness, but it usually left before noon. He wondered what his trouble was and thought perhaps it was due to a cold that had been plaguing him for about a week. He was partially right at that.

To help in knocking out the cold, he procured some anti-histamine pills. He had heard and read many cure-all claims for this type of self-medication. Now he was taking one of these pills every four hours. He wasn't sure if they helped very much or not. He did know, however, that he was not feeling very well.

Here we can see an accident just looking for a place to happen. There was one more significant item building up toward the accident in which he was to be involved. That was his oxygen mask. It didn't fit very well. In fact, when he turned his head it leaked rather noticeably near his chin.

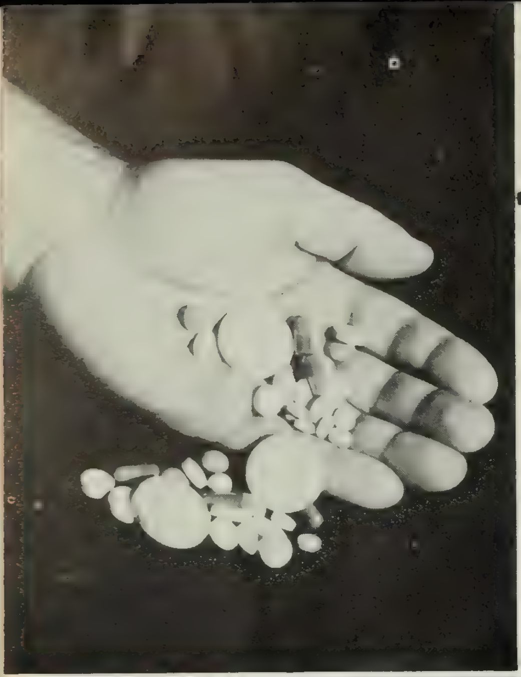
This officer was a walking medical museum of reasons why one should not fly. To start with the simplest of his afflictions, the cold from which he was suffering could have been reason enough to ground him. Further complications evolved around a serious case of carbon monoxide poisoning. We'll get to that a bit later. It's enough to note here that the lieutenant ran out of luck all of a sudden.

Incredibly, this pilot, saddled with a cold, under the influence of hypnotic drugs, suffering from carbon monoxide poisoning and afflicted with an ill-fitting oxygen mask, started his jet and took off for a high altitude mission.

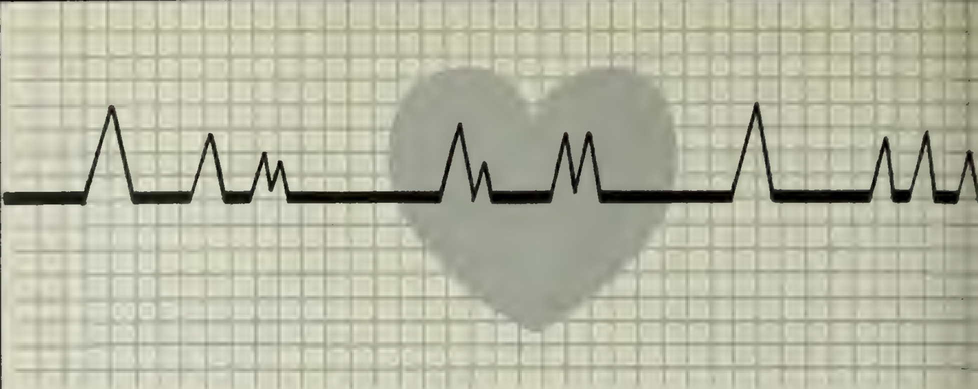
What is still more incredible is that this lieutenant flew to over 30,000 feet, cruised there for a while and then brought his plane down for a landing. He was groggy and bleary-eyed to be sure but he still possessed the fundamental rudiments of flying technique. He landed the plane short and wiped out the gear. He, himself, was unhurt.

It was not until the next morning when the effects of his various poisons had worn off, that he was mentally alert enough to grasp the seriousness

Suffering from a cold and hypnotic drugs, the pilot landed the aircraft short, wiping out the gear.



Self medication is often harmful. Be sure to see the Flight Surgeon if you're sick.



of the previous day's conduct and probably wonder at whatever guidance it was that brought him down safely.

From a medical viewpoint, whether or not an individual should fly with a cold depends on many factors. However, in general it may be said that if the cold is mild usually there will be no ill effects from flying. But if the cold is severe, and especially if it is of the type known as a head cold, serious consequences may occur, particularly if the flight is being conducted at a high altitude.

Pilots have suffered serious ear conditions from flying with a cold and there have been cases where pilots and crewmembers have experienced such excruciating pain from sinus trouble during rapid descent that it was difficult to maintain consciousness.

The actual decision as to whether or not the lieutenant should have flown with his head cold should have been made by the flight surgeon. In this case, however, the cold was certainly the least of his physical troubles. The treatment the lieutenant was giving himself was a far greater hazard to flying than the cold itself. You probably have heard the saying that "he who treats himself has a fool for a doctor." It's just dangerous business. That body of yours is a delicate and complex machine.

Some of the so-called cold pills contain a drug which is medically known as anti-histamine. This is the type the lieutenant was feeding into his system. For some people, particularly those whose colds are associated with allergies or hay fever, this type of treatment may be very beneficial. However, like all drugs it should be taken carefully. Furthermore, the anti-histamines have an added property which is known as being hypnotic. In other words, it causes drowsiness and lack of mental alertness.

Even under normal conditions those drugs should be taken judiciously and under the supervision of a physician. We must remember too that any anti-histamine is not compatible with flying. Current regulations state that no one should fly within 24 hours after taking such medication.

You'll remember that our lieutenant's troubles first started from a series of headaches. The man himself might have been able to realize the cause of his troubles if he had thought back to his cadet training days and recalled something about the lectures on the dangers of carbon monoxide. He might have remembered that carbon monoxide is a toxic gas and that even a small amount, such as may come from incomplete combustion in a faulty gas heater, can produce dangerous physical symptoms.

Certainly he should have been aware of the dangers of inadequate ventilation in his own home. And, if he forgot all of this, he should have remembered the symptoms of carbon monoxide poisoning. We all had it drilled into us time and time again. Remember them? Headache, dizziness, weakness, sometimes nausea and vomiting and then, if too much of this gas is inhaled, stupor, unconsciousness and finally, death.

The reason that carbon monoxide is so deadly is that it may be taken up by the blood very easily. In fact, it is absorbed by the blood over 200 times more readily than oxygen. It doesn't take long to put one out of the picture.

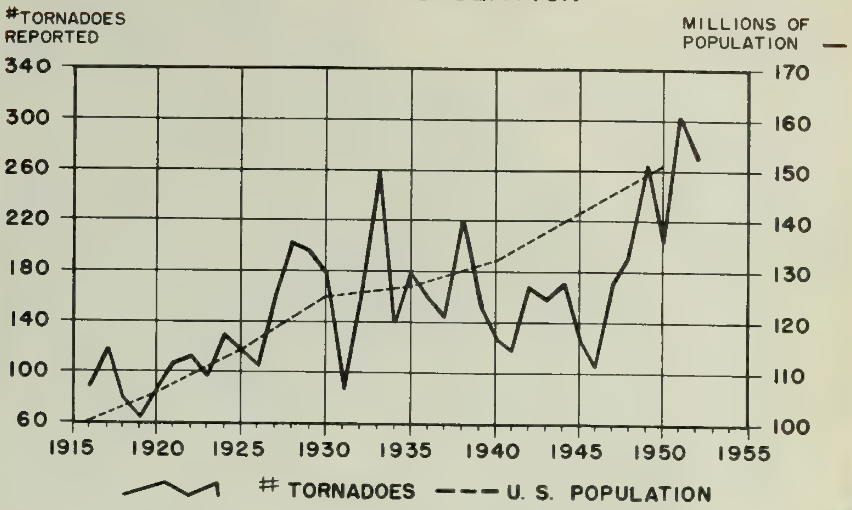
What is particularly hazardous about carbon monoxide poisoning and flying is the effects of altitude. As in the case of this lieutenant, an individual may have only part of his blood saturated with carbon monoxide and still be able to walk around, although not feeling too well. However, when pilots go to altitude, they encounter conditions where there is less and less oxygen or less and less atmospheric pressure to push the oxygen into their blood. When the reserve of oxygen carrying power is compromised by being partially occupied by carbon monoxide, stupor or unconsciousness may occur very easily.

The striking thing about all accidents attributable to poor physical condition is that they are 100 per cent preventable. Maintaining good physical condition and giving reasonable concern to health is such a biologically sound principle it's strange that some people attempt to evade it.

No one will ever be censored for turning to the flight surgeon in times of doubt. On the contrary, the strength of the Air Force depends on healthy and willing personnel. Self-appraisal of illness or injury has never proven of any value to the Air Force or the individual; it has cost us both lives and dollars. ●

**This is the critical time of year for one of nature's most violent killers, the tornado. You can help to . . .**

TORNADO REPORT FREQUENCY CONTRASTED WITH U.S. POPULATION



# Tame the Twister!

THE year 1953 was characterized by an unusual number of tornadoes in the United States — 454 were reported and that's an all-time record. Such tornado activity has accounted for severe loss of life and property.

It is interesting to note that although 1953 appeared to have been a banner year, it may be pointed out that all the government weather services have joined with the Atomic Energy Commission in denying that atomic tests in the spring of that year could be responsible for the increased number of tornadoes reported.

The number of tornadoes reported each year from 1916 through 1952 is given in the accompanying table. In view of the apparently increasing trend, it was decided to plot the population increase in the U. S. over the same period and this is shown as a dashed line. The most plausible explanation for the roughly parallel increase in tornadoes and population is that the population growth in the Middle and Southwest has resulted in an increased number of tornado reports from this tornado-prone area.

You may remember a few short years ago when two separate tornadoes hit Tinker AFB. The damage was tremendous and the cost went clear out of sight. It was right then that the Severe Weather Warning Center's system of forecasting tornadoes was conceived by two local weather officers.

The basic mission of the Center is to warn Air Force bases whenever the possibility of a tornado exists in a particular area. The Center is, in effect, an advisory service. Once they spread the word, the local weather officer has to grab the ball and carry it until all danger is past.

Forecasting where a tornado will hit, with any degree of accuracy, is virtually impossible. However, the mere fact that an area has been declared in the "possible" class is enough to set the wheels in motion. The life of these monsters is relatively short (about one hour average) and that leaves little time to do more than properly secure a base and let 'er blow.

A particularly interesting pamphlet, titled "Tornadoes and Related Severe Weather" was published by the Air Weather Service on 15 February 1953. This booklet may be found in every Air Force weather office and should be consulted by key personnel in tornado areas. There's a wealth of information available in the little publication.

Commanders and weather officers should establish a very close liaison at stations where the big blows may strike. The Severe Weather Warning Center issues what they call Progressive Alerts over the AWS teletype circuits and all installations within the suspected area are kept informed of the tornado's progress. However, once again, it is the base weather officer who must watch local conditions carefully.

You may wonder how you as a pilot can assist in the tornado warning program. Here are a few suggestions from AWS. Keep them in mind if you find yourself flying in an area that looks suspicious:

☆ If you note any activity that makes you suspect tornadoes are close by, pay particular attention to the *type* of clouds in that area. Normally, heavy cumulonimbus build-ups will be in evidence.

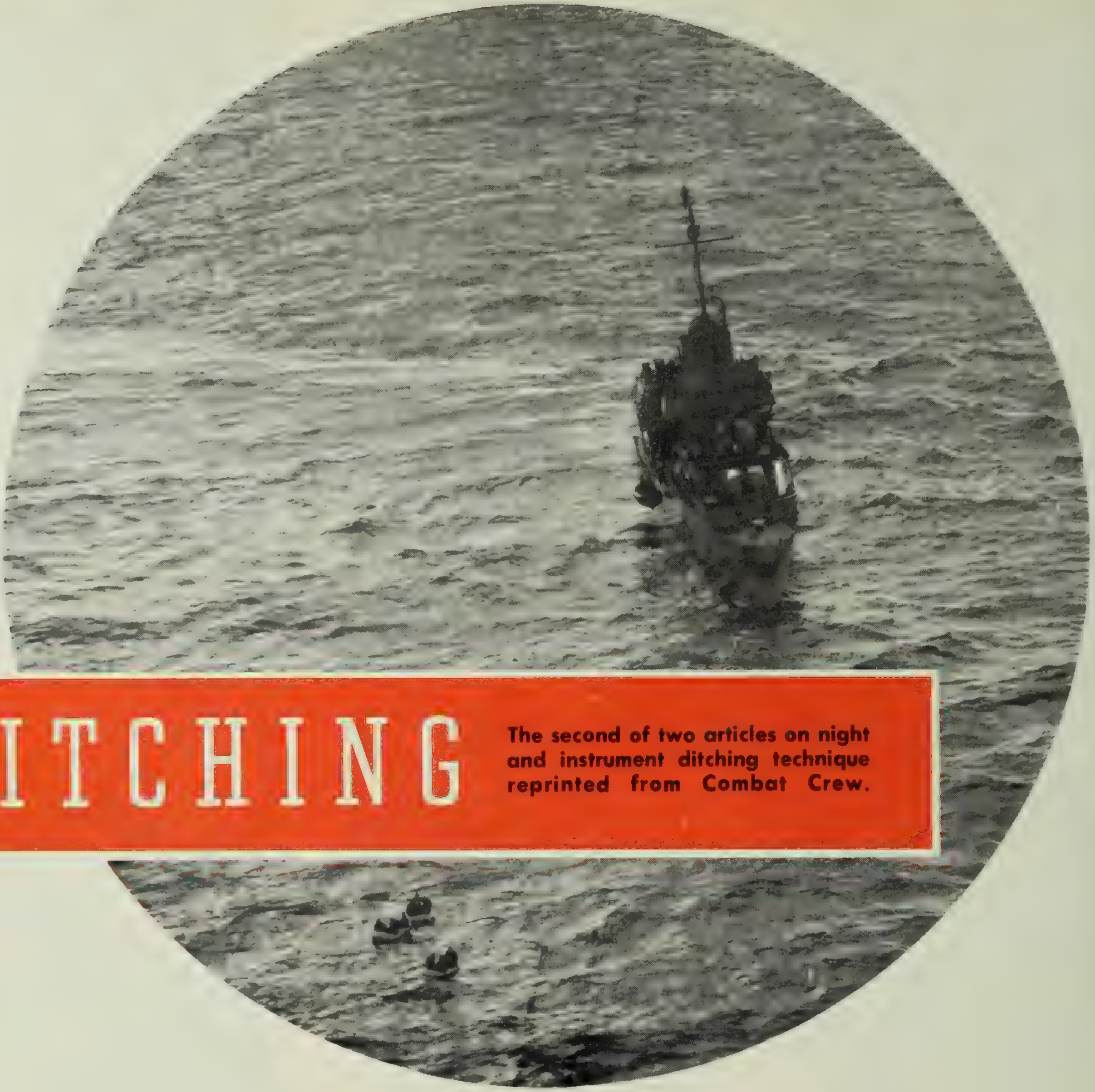
☆ If possible, get a good reading on the wind at your altitude, speed and direction.

☆ If you encounter hail (which is very possible in a tornado area) attempt to evaluate the size of the hail and note, insofar as possible, any structural damage. Structural damage will be in direct proportion to the size of the hail encountered.

☆ Note the degree of turbulence you encounter both on entering and leaving the suspected area.

☆ Call the nearest radio facility and give them the information as soon as possible. In addition to the above information, be sure to include your aircraft type and your airspeed. And at your first stop, give the local weather officer a thorough briefing.

Believe it or not but this kind of information will prove of real benefit to the AWS people. Until the day comes when specially instrumented aircraft and trained crews are available to track these storms, *you* can do your bit in assisting in forecasting the paths of these home wreckers. ●



# DITCHING

The second of two articles on night and instrument ditching technique reprinted from Combat Crew.

### By LCDR John M. Waters, Jr., United States Coast Guard

IN SOME instances, the pilot of a stricken aircraft faced with a potential ditching may be fortunate enough to have a surface vessel in the vicinity. During daylight he can ditch alongside and expect to be retrieved in short order. At night, unfortunately, very little help in ditching can be expected from the average merchant vessel because of its lack of facilities and unfamiliarity with a pilot's needs.

The ocean station vessels operated by the U. S. Coast Guard have been given extensive training in procedures for the ditching of aircraft, and a heavy training program has been scheduled for them this year.

As each vessel reports in to Bermuda for her 25-day tour of duty, personnel are given lectures, drills, at-sea training with aircraft and flights as members of aircraft crews. This is to acquaint them with the requirements of aircraft in distress. During a recent eight-month period, 16 ships were processed through this program. In the final exercises of the training period, they were required to locate a lost aircraft by means of electronic aids, vector it to the ship and assist the landing by radar with a simulated 300-foot ceiling and one-mile visibility, in addition to providing illumination for the final approach. This program is conducted by aviators who rotate between the ship and the aircraft so they may constantly check the progress from both sides of the picture.

This training has already paid dividends. Recently a Coast Guard cutter assisted a lost aircraft to Bermuda and a landing at the airport when the weather was 300 feet below field minimums. The aircraft had less than an hour's fuel remaining upon arrival over the island. Had the first two approaches failed, they were going to ditch the plane beside the ship which was lying five miles off the island. Fortunately it got in on the first pass.

The facilities and capabilities of these ocean station vessels with their modern electronic equipment are not generally known by pilots. They can be of tremendous help, not only in helping when an aircraft is in distress but in giving timely assistance which will prevent an emergency from developing. We divide the problem of assisting distressed aircraft into the following components:

- Establish and maintain rapid and reliable communications.
- Locate the aircraft.
- Steer it to the ship or to a safe alternate.
- Provide weather and sea condition information.
- If IFR, provide a radar assisted approach or radar assisted ADF approach.
- Provide flare illumination for ditching.
- Rescue and care for survivors.

Familiarity with these components is of vital importance to pilots using these facilities and will make for more effective operations by the OSVs.

### Rapid and Reliable Communications

In addition to guarding the aeronautical frequencies, the ship is in continuous communication with its operational commander in New York and the Rescue Coordination Center there. As a result, if a pilot initiates a distress call to an OSV, the RCC is immediately advised, and they in turn throw the entire rescue organization into action. A pilot will probably initiate a distress call through his ground control station. Once an emergency is declared, no effort is spared to assist him. The nearest OSV proceeds toward him and naval and merchant vessels as well as passing aircraft are diverted to help. Within ten minutes after his call, rescue aircraft will be airborne and proceeding to a pilot's assistance. The high-frequency direction finder net will commence taking bearings on his transmissions as he talks and will fix the position accurately. This is all dependent on reliable communications.

### Locate the Aircraft

One of the most effective navigational aids, and one that is always available, is the OSV's radio beacon. It usually can be picked up at about 150 miles and enables the aircraft to home to the vessel.

Another extremely reliable aid is the ship's radar, and this is effective at 50 to 70 miles. We hope shortly to have even better equipment. If the aircraft has a defective ADF, or is unable to pick up the ship's radio beacon, the ship can take bearings on the aircraft with the ship's direction finder on any frequency between 200 and 1750 kc. These bearings are not for normal navigational service, but only for emergency use.

Many aircraft flying the ocean are unable to transmit in the low frequency band. In case of emergency, distress signals may be transmitted on 500 kc by attaching the Gibson Girl antenna to a trail or fixed antenna of the aircraft and cranking the Gibson Girl. This will transmit an SOS, enabling bearings to be taken. If none of these aids can be used, the plane should furnish the ship with a Loran or celestial line of position, if possible, or any information on weather that may allow the ship's aerographers to estimate its position.

In the meantime, the high frequency direction finder net will be taking bearings on the distressed aircraft as transmissions are made, and will be furnishing the SAR commander with this information. If you are in distress, and working a ground radio station on one of the normal aeronautical frequencies, radio fixes are being plotted on you by the HF/DF net, often without your knowledge.

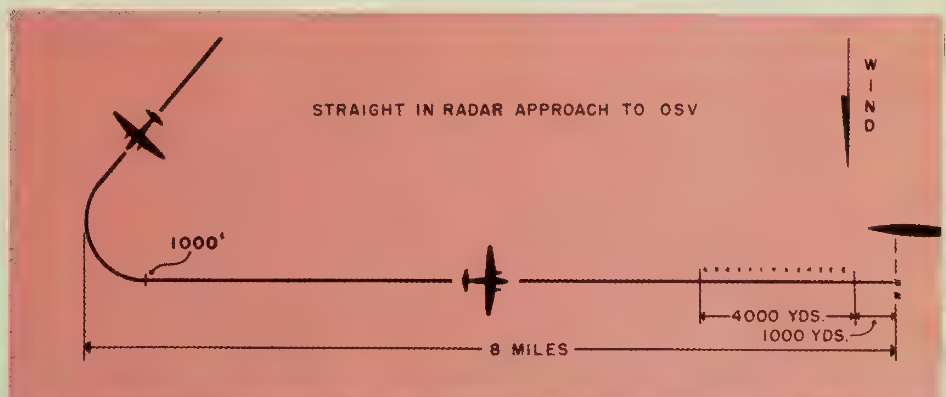
Once a fix has been obtained, the aircraft is given a heading to bring it to the ship. When the aircraft is first detected on radar, it will be tracked for a few miles. If the course and speed as plotted agree with those that the aircraft is flying, the pilot will be given a 90-degree turn for about three minutes for positive identification. Once identified, he will be vectored to the ship.

While inbound, the ship will give the weather and sea conditions at its position. On the basis of this, the pilot should advise the ship what his intentions are, and, if he intends to ditch, on what heading. If possible, use true headings rather than magnetic when working a ship, as it greatly simplifies their problem. If it is necessary to steer magnetic, however, they will give all headings in magnetic. The selection of ditching heading is a command responsibility of the pilot, and we discourage ships' captains from recommending one unless specifically requested by the pilot.

While the aircraft is inbound to the ship, all necessary information on type of approach to be used, illumination procedures, instrument approach procedures and the number of people aboard should be exchanged so that no delay is involved when the plane reaches the ship. In most cases of ditching, there will be time enough to plan logically. If the case is urgent, the ship must know the selected ditching heading as soon as possible so as to commence laying sea lane markers when the aircraft is 15 minutes out.

### Marked Sea Lane

If the ditching is to occur under night or instrument conditions, a sea lane consisting of a single row of float



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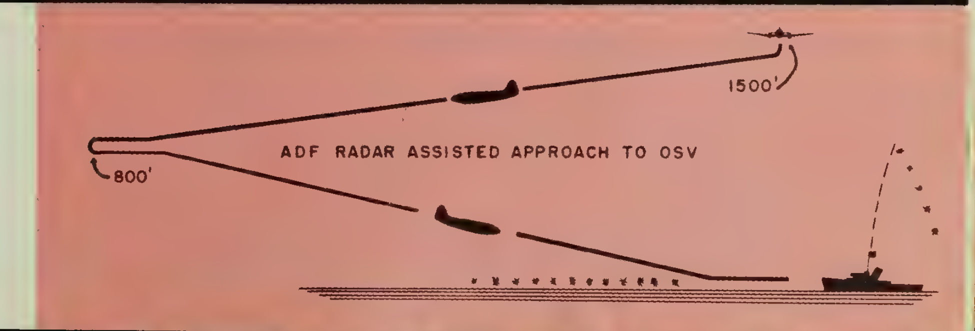


lights is laid out. These lights are 200 feet apart and the line extends for 12,000 feet under IFR conditions, and 6000 feet under night VFR conditions. This sea lane aids in lining up for approach, in judging altitude, in marking the ditching spot and in making contact and in shifting from instrument to visual flight.

The ship will be lying upwind of the sea lane so that her high altitude flares will be over the sea lane during the middle of the burning period. At first, our doctrine called for the aircraft to touch down beside the sea lane, just as it would on a lighted runway or seaplane landing area. This has met with great disfavor from many of the airline pilots and some military pilots, due to the possibility of gasoline from ruptured tanks being ignited by the open-flame float lights. To overcome this objection, we moved the ship 1000 yards beyond the last sea-lane float light so that the ditching occurs well clear of the burning float lights.

Once the sea lane lights are laid and the ship takes up position to the side and 1000 yards beyond the sea lane, the pilot can begin his approach. If the night is clear, approach will be the same as an approach to a lighted runway. When the aircraft is five miles from touchdown, illumination with high altitude mortar flares and star shells will commence.

### Radar-Assisted Approach

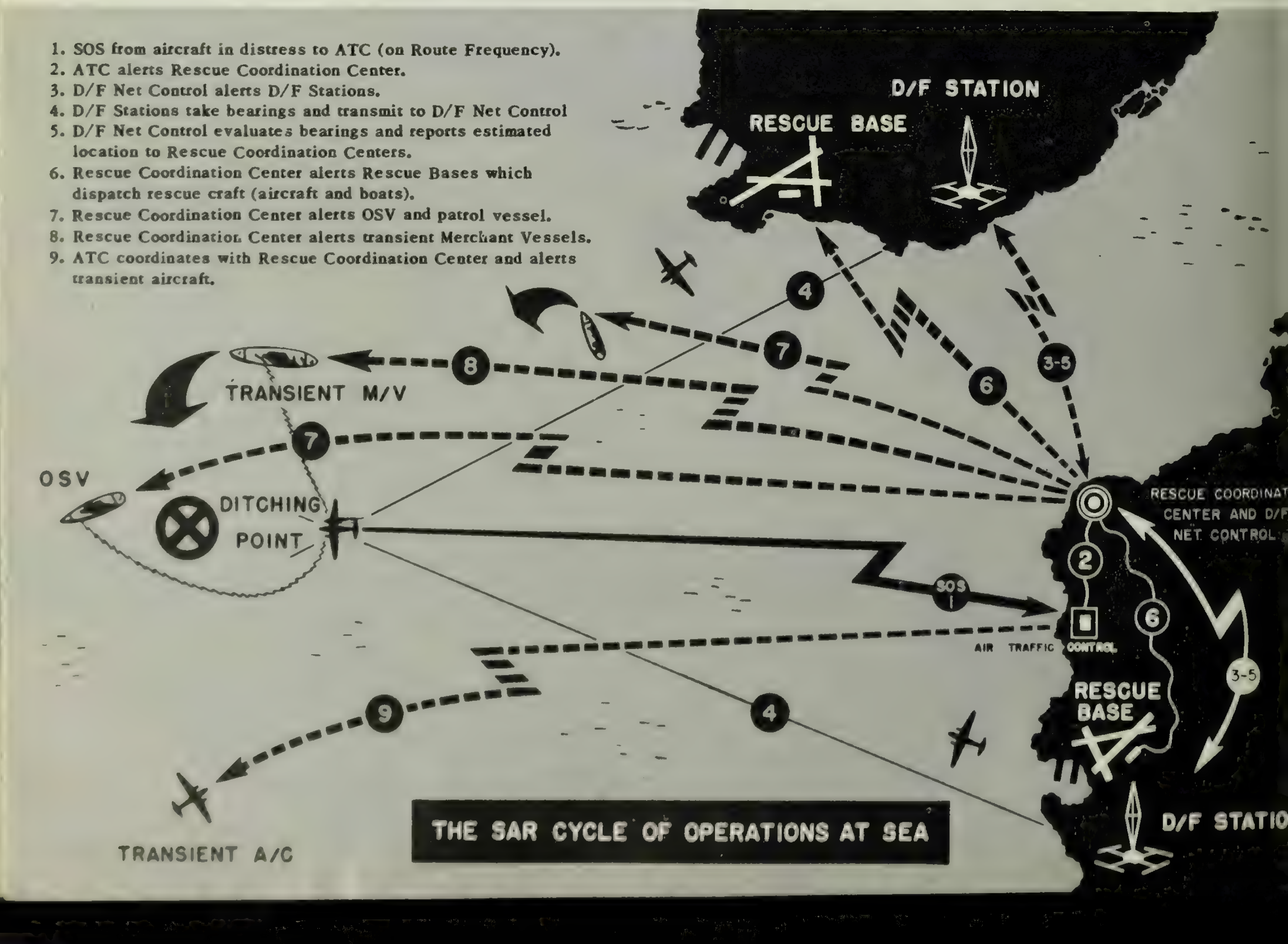
If instrument flight conditions prevail, an instrument approach must be made. We utilize three different types of approach: the pattern radar approach; the straight-in radar approach, and the radar assisted ADF approach.

Each has its advantages and shortcomings. If the aircraft is able to maintain altitude, and has sufficient fuel, we can utilize a pattern approach. The aircraft is vectored over the ship at 2000 feet. It is then turned onto the four-mile initial leg of the pattern and the pilot is instructed to descend to 1500 feet. When four miles from the ship, the plane is turned to its downwind leg and the pilot instructed to descend to 1000 feet. (When we refer to downwind leg here, we mean the leg which is the reciprocal of the ditching heading and not necessarily true downwind.) The plane is then turned on base leg and told to descend to 800 feet.

During the approach thus far, the pilot has been given headings to steer, a constant flow of information on his position with relation to the ship and altitude assignments. The approach is being made on the air search radar, and as the ship has no means of determining the height of the aircraft, altitude assignments are made as recommendations.

As the aircraft approaches the final leg, it is turned on final heading eight miles from ditching point and the pilot is told to descend at his own discretion. This will normally be at about 300 feet per minute. Headings and ranges to touchdown are given until less than a mile from the ship. When the airplane is four miles out, it is picked up on the surface search radar which is more accurate than the air search, and this radar controls the plane during the critical last four miles.

Usually contact can be held until the aircraft is within 1000 yards of the ship, at which point the pilot already should have made visual contact. If the aircraft is below the base of the overcast when two and a half miles from the ship, the pilot should be able to see the sea lane float lights and can follow them to the ditch point. As the aircraft reaches a point five miles from the ship on final approach, the ship begins illuminating with high altitude mortar flares and continues


1. SOS from aircraft in distress to ATC (on Route Frequency).
2. ATC alerts Rescue Coordination Center.
3. D/F Net Control alerts D/F Stations.
4. D/F Stations take bearings and transmit to D/F Net Control
5. D/F Net Control evaluates bearings and reports estimated location to Rescue Coordination Centers.
6. Rescue Coordination Center alerts Rescue Bases which dispatch rescue craft (aircraft and boats).
7. Rescue Coordination Center alerts OSV and patrol vessel.
8. Rescue Coordination Center alerts transient Merchant Vessels.
9. ATC coordinates with Rescue Coordination Center and alerts transient aircraft.

THE SAR CYCLE OF OPERATIONS AT SEA

this illumination until after the plane is ditched and personnel are evacuated. These flares ignite 1000 feet in the air, and each produces 80,000 candle-power. Because about four are burning at all times, 320,000 candlepower is available for ditching.

The pilot should touch down just short of the flares, and must under no circumstances overshoot, or he will pass from an area of bright illumination into darkness and will be blinded. If any error is to be allowed, the pilot should land short.

If the aircraft is short on fuel, losing altitude or some other factor makes an immediate ditching imperative, we can use a straight-in radar assisted approach instead of the pattern approach. Once radar contact is made, we commence vectoring the plane direct to a point eight miles from the ship on a bearing which is the reciprocal of the selected ditch heading. We advise the pilot to descend so as to be at 1000 feet at the turning point. As he arrives at the point, we turn him on final and the procedure is the same as in the final leg of the pattern approach.

Recently, we demonstrated radar approaches of this type to a large group of military and air line pilots. One experienced commercial pilot objected when the controller aboard the ship gave two 10-degree course changes to the plane when it was within two miles of the ship and below 200 feet. Other pilots agreed with him, and we believe this objection has much validity. We intend, during exercises this year, to give the pilot his last instructions on heading when he is three miles out, even if he is off to the side of his track line. We believe that it will be better to put the aircraft in on a good heading with wings level than to risk turns on the water, even if the illumination may not be as satisfactory.

The accuracy of radar approaches varies with the state of training of the ship, but on the average compares favorably with that which would be possible on a radio-range approach. The shipboard Combat Information Center personnel are well trained. They are expert plotters and radar personnel, but they are not aviators.

During training periods, they receive thorough ground work in aviation procedures so they will know how to best assist the pilot in distress. Nevertheless, in any radar approach a certain amount of control is taken from the pilot and placed in the hands of the surface radar controllers. In an effort to avoid this, the Coast Guard developed a third type of approach—the radar assisted DF approach.

Any pilot holding a valid instrument rating has performed numerous ADF approaches. This procedure could be used easily to make an ADF approach on the radio beacon of an OSV except for the fact that our low cone is at the same position as our landing point. This can be overcome easily, however, if continual radar ranges are available to the pilot. The procedure evolved is as follows:

The distressed aircraft homes to the OSV on ADF. When within radar range, the ship will assist the aircraft in homing-in, and will prepare the sea lane as described previously. When over the ship, the aircraft tracks outbound on a heading which is the reciprocal of the selected ditch heading, and descends so as to be at 800 feet when completing the procedure turn. Procedure turn is made four minutes out. The aircraft then homes to the ship on the selected ditch course, letting down in order to make contact before reaching the ship. To assist the pilot, the ship feeds him constant radar ranges and will also advise him if he is to the left or right of his intended course line.

Illumination will commence at five miles, as previously described. During this type of approach, selection of heading and altitudes is a responsibility of the pilot, and the ship assists with range information only. Control remains in the cockpit.

This procedure does have the disadvantage that a defective ADF will adversely affect the approach, and atmospheric disturbances will often throw the needle off. This was proved conclusively during exercises when the ADF needle of an aircraft, making this type of approach to the ship, pointed to a nearby thunderstorm instead of the ship's beacon, and a missed approach resulted.

During all instrument approaches, a pilot should bear in mind that prior to reaching the illuminated area there is a string of lights 12,000 feet in length that will guide him to the ditch point if he establishes visual contact over the sea lane. It is recommended, that on any type of instrument approach to an OSV, the pilot keep his ADF on the ship's beacon as a double check on the vectors being given by the ship. ADF can be used also to make an approach to a merchant vessel if the merchant vessel will transmit

signals on a low frequency. Transmissions should be 20-second dashes as the ADF needle functions best on continuous tone signals.

High altitude mortar-flare illumination will commence when the aircraft is five miles out on final. For an approach under instrument conditions, this is the only illumination provided, because of certain technical considerations. For an approach under visual flight conditions, however, we provide high altitude mortar flare illumination beside the ship in the same manner as for an instrument approach, and, in addition, provide another area of illumination 3000 yards farther ahead by means of star shells from a five-inch gun.

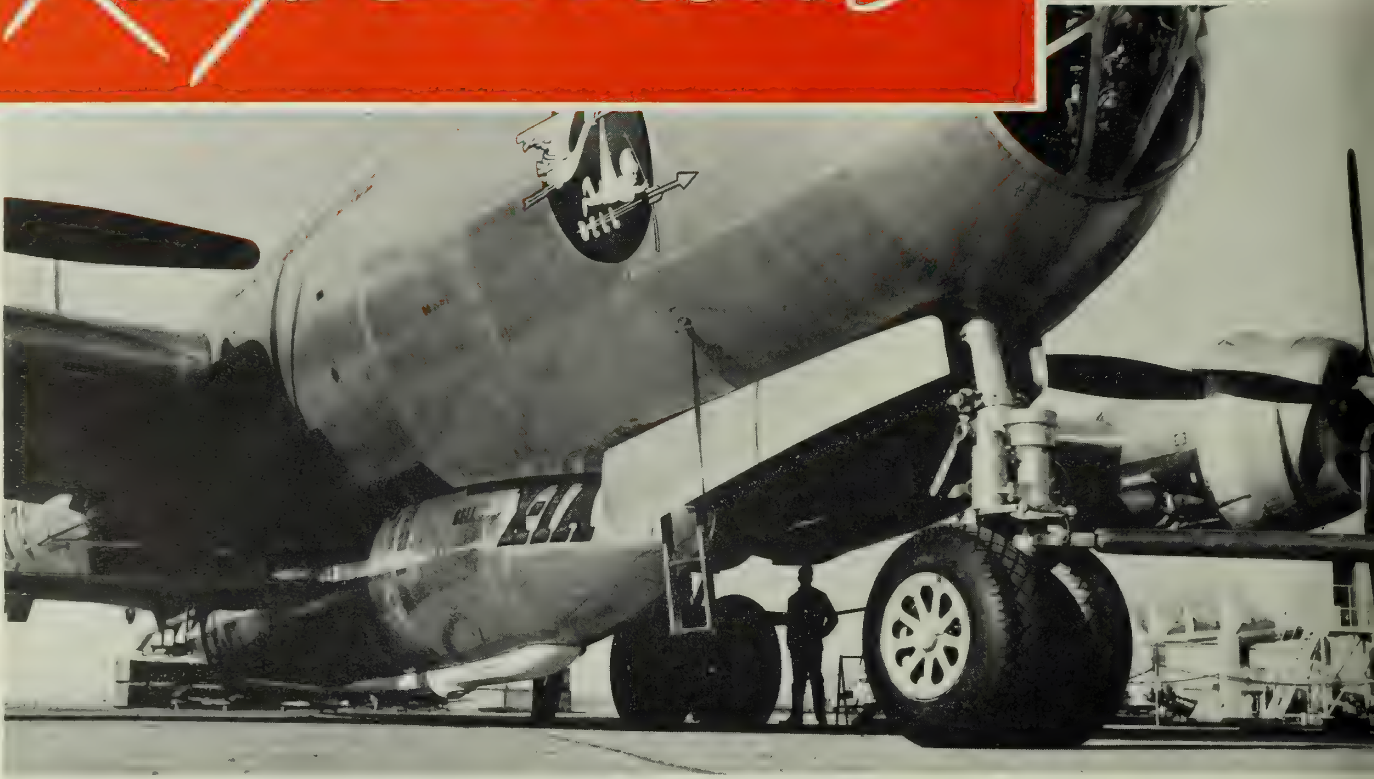
The only purpose of the star shell illumination is to provide a visual horizon and ditch spot in case the aircraft overshoots the illuminated area beside the ship.

Rescue of ditched personnel is much too broad a subject to be taken up in detail here. This is a matter of good seamanship and will depend on the conditions prevailing at the time. Rescue normally will be accomplished by ship's boats and rubber rafts, or the ship will lay alongside the survivors and drop rubber-suited swimmers into the water to help. In either case, the ship will be only a few hundred yards from the aircraft when it ditches, and help will be available in minutes. Evacuation of the aircraft is a matter for the aircraft's personnel to handle, and normally help cannot be expected from the ship in accomplishing this. The ship, of course, will maintain illumination while the aircraft is being evacuated.

In summary, no matter how black the night or how stormy the weather, the situation never is hopeless if aircrews know what to do and do it promptly. Search and Rescue units stand ready day and night to assist anyone in distress anywhere. It is hoped that no one reading this article will be forced to ditch; however, if assistance is needed, remember: help is never far away. ●

# Keep Current

NEWS AND VIEWS



Secured in the bomb-bay of a specially modified B-29 mother ship, the X-1A is being towed to the propellant tanks for fueling.

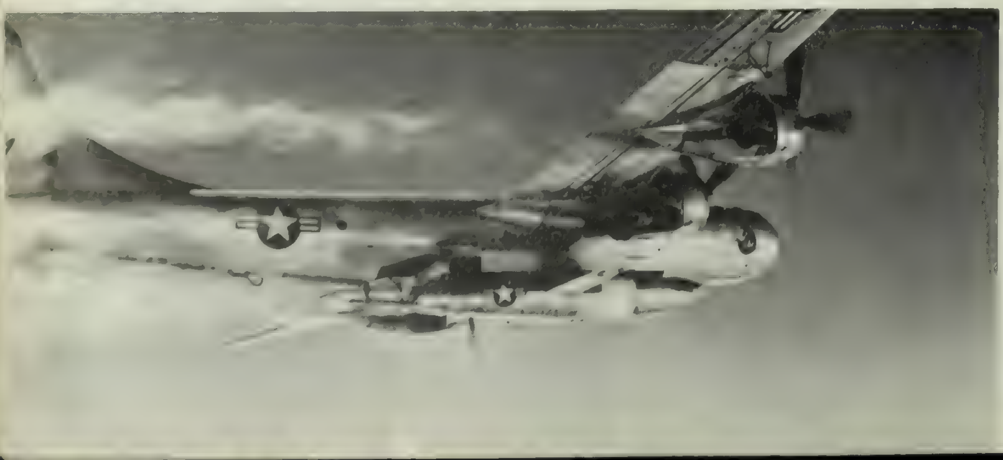
THIS month, FLYING SAFETY brings its readers a picture story of the rocket-powered X-1A on a test flight. A research aircraft built for the USAF by Bell Aircraft Corp., the X-1A was flown on 12 Dec. 53 by Major Chuck Yeager, the world's "fastest man," at over 1600 mph.

The record flight of the X-1A ended the first 50 years of powered flight with a marked contrast — the Wright Brothers' plane flew less than seven miles per hour — and opened a new era that is limited only by man's ability and imagination.

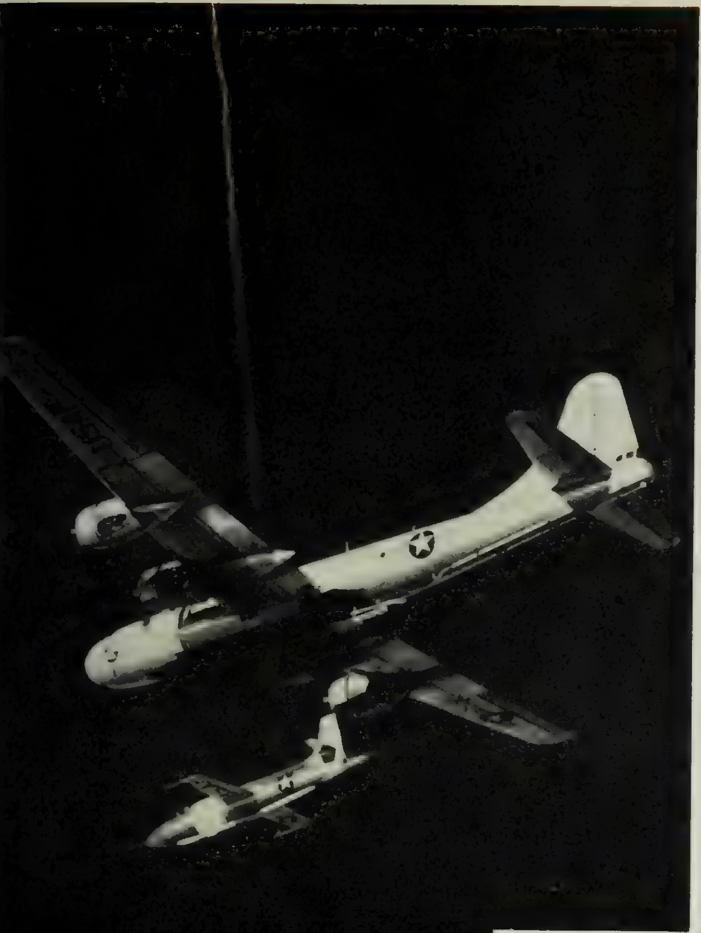
Barreling through the sky at 70,000 feet, Major Yeager, a top Air Force test pilot who made the first supersonic flight six years ago, earned the right to the title of the "fastest man in the world." After being dropped by a B-29 mother ship at 30,000 feet, Chuck gradually poured on the power, climbed to 70,000 feet and flew the X-1A at more than two and a half times the speed of sound. At this speed the aircraft was traveling twice the speed of a bullet fired from a .22 calibre rifle or more than 300 mph faster than any airplane had ever been flown before.

The X-1A is the fifth of the X-1 series built by Bell, and is essentially the same plane as that designed in 1945. It is five feet longer than the original X-1, has a larger fuel tank and is equipped with a turbine pump to force-feed the rocket fuel, an alcohol-water mixture and liquid oxygen, to its four rockets.

The four rockets develop 6000 pounds of thrust and supply full-powered flight endurance for 4.2 minutes. ●



Mother ship prepares to launch X-1A. White band forward of X-1A wing is frost caused by condensation on liquid oxygen tanks.

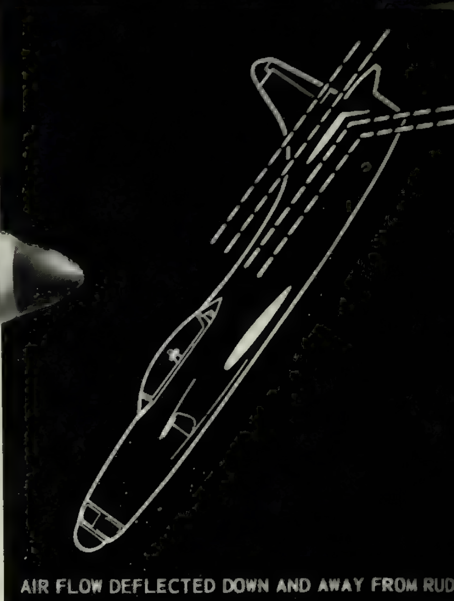


Above, the X-1A is not a tactical aircraft. It uses the sky as a giant wind tunnel to solve problems of high speed. Below, fuel exhausted, the X-1A glides in to Edwards AFB.

Above, dropping clear of the B-29, Yeager fires the rockets and the X-1A begins record flight, attaining airspeed of over 1600 mph.

Above, after flying at 2½ times the speed of sound, X-1A lands on dry lake bed.

Lawrence D. Bell, President of Bell Aircraft Corporation, congratulates Major Yeager on his record breaking flight in the X-1A.



AIR FLOW DEFLECTED DOWN AND AWAY FROM RUD

# THE "C" AROUND YOU

**By Sammy Mason, Flight Test Pilot, Lockheed Aircraft Corp.**

WHEN I was first asked to do a story on spinning the F-94C, by FLYING SAFETY, I wondered what there was to tell. After all, I reasoned, the Pilot's Operating Instructions cover the subject adequately and I was sure the magazine didn't want a rehash of the dash one. Still, the Director of Flight Safety Research had asked that the spin characteristics of the "C" be analyzed, so there must be a reason behind such a request.

You know, it's funny how many angles a man will come up with when thinking seriously on any given subject. The more I thought about spins in the F-94C and the more I reviewed the Operating Instructions, the more I realized that although the manual is complete insofar as basic principles are concerned, there are still some fine points worth considering.

About the only way I can lead into a piece like this is to discuss some typical spins. After riding through several hundred in any one type of aircraft, they become almost commonplace, but still, I'm of the school that believes that every flight and every maneuver will teach something new, so let's run over some typical spins in the F-94C.

I don't care whether you're going to fly a Maytag Messerschmitt or a Starfire, the first thing you must do is to complete a thorough preflight check of the plane and make certain that all loose objects are tied down in the cockpit. This is especially vital when you are planning any acrobatic maneuvers including spins.

We've all had our share of odds and ends flying around the office unexpectedly, such as bucking bars and wrenches and it just isn't fun. So — I say again. Make that preflight check complete and thorough.

Okay, so we've completed our ground checks, fired up the plane and have climbed upstairs to about 25,000 feet. Everything is going along fine and we're ready to do some spins.

First things being first, we clean up the cockpit, trim the plane for level flight and then clear the area carefully. Remember how your instructor taught you to roll that old PT around before you started any acrobatics? You made certain that you had plenty of air around you that was not cluttered up with other airplanes. This is a two-way proposition. You don't want to spin into some poor, unsuspecting soul, and by the same token, you could get a bit irritated if someone came clobbering into your cockpit. So, clear the area carefully.

Now, let's put our F-94C into a normal entry, spin and recovery. Believe me, it's a simple maneuver and I feel you're going to enjoy it.

We'll make this first one nice and clean. Let's check. Gear, flaps and dive flaps all tucked in? Okay, now throttle back to Idle and pull the nose up slightly. Like any jet, the plane seems slow in decelerating but as the speed falls off we start easing the nose up, even more. Nothing extreme, mind you, just a nice clean stall.

The "C" is a kindly aircraft and gives you a lot of warning before it finally pays off. You'll feel it begin to shudder a little and it's right then that we'll feed in plenty of stick and rudder. Remember, this baby is truly spin resistant and it takes a bit of serious effort on your part to get it to heel over and slip into that spin.

You'll note that the rudder forces are rather heavy, especially when we have it trimmed for forward CG, and then as we actually get winding up in the spin, the control forces will increase. By that I mean the forces necessary to hold the plane in the spin. At the same time we begin to encounter a lot of buffeting, mostly tail buffeting. With that forward CG, I prefer not to wind up over a couple of turns for it takes a lot of control pressure to hold her in the spin, and buffeting will increase.

Now to stop it. One easy and sure way is just to release all control pressures. That's all there is to it. You relax and the plane stops spinning right now.

There's been a lot of discussion recently as to various spin recovery techniques. Apparently there are several schools of thought on this subject. However, as far as I'm concerned, stick full back is important while using the rudder to effect a spin recovery. Understand now, I realize that any good airplane will recover from a spin unassisted, but, to stop that rotation right on the button, lead with the rudder and after rotation has stopped, release that back pressure. The NACA people too, recommend this procedure and take it from me, it works nicely.

Again I repeat, trim means a great deal insofar as recoveries are concerned in the '94C. With aft CG you can actually hurry things by pushing the stick forward but with CG trim ahead, you'll find that the back pressure is so heavy, merely releasing it will bring about a responsive reaction. The stick will pop ahead on its own accord if you give it a chance.

The discussion of ailerons in spin recovery still crops up now and again. I do not recommend using aileron in the 94C, in fact, I'm against that practice in almost every airplane I've ever flown.

Actually, in the 94, with a forward CG condition, use of aileron doesn't hurt anything but it may speed up the rotation a bit if you use aileron with the spin.

At aft CG we have a different picture. Aileron control against the spin has a tendency to flatten it out a lot and will louse up the rudder and elevator control a great deal. Then too, if you get a spin stopped while still holding in aileron pressure, the chances are good that the ship will flop and spin in the opposite direction. So remember when you have an aft CG condition, keep the ailerons in neutral.

Actually, in discussing forward and aft CG positions, I am trying to brief you on any possible spin condition you might encounter. Normally, the only time most pilots will fly the F-94C in an aft CG condition is after the nose rockets have been fired. If no rockets are carried, ballast or dummy rockets are installed to maintain forward CG position.

Here's another good thing to remember — and, this applies to most aircraft, especially if the CG is aft. If you are a bit early on the stick when effecting a spin recovery and haven't given the rudder time to take hold and stop the rotation, then you are very likely to experience a momentary speedup in rotation. This can be disconcerting to a new pilot and has probably led to some premature ejections.

Just to prove my point, I've deliberately cranked the F-94C into a spin and then pushed the stick clear forward while continuing to hold hard rudder with the spin. The plane begins to revolve like the well-known button and there is no indication of a recovery. She just keeps on boring around. Some airplanes will get real nasty under these conditions but fortunately that does not apply to this one. All you have to do for recovery is pull the stick way back, feed in opposite rudder, and *after* it takes effect ease the stick forward.

You've all heard of getting out of phase in handling controls. Well, that can happen in a spin recovery attempt. You yank, pull, push, panic and eject! 'Tain't necessary. Just get back in phase and try again. Remember, feed in opposite rudder to the direction of rotation and keep the stick back. Rotation will stop. Then release back pressure for a normal spin recovery.

Now here's another point to remember which applies to any well designed airplane. If you get in a spin with full tips and the CG is well aft, and all of a sudden get in such a hurry to stop the spin that you leave opposite rudder poked in, well, in all probability, the plane will stop spinning, pause for a second or two and then flop the other way. Maybe you'll say that's elementary stuff, and you're right, but, I've known some real sharp guys that forgot elementary stuff and wound up permanently dead.

You're probably wondering how long it takes for the "C" to stop spinning under normal conditions and in clean configuration after recovery control pressure is applied. That's an easy one. Allow about one-eighth of a turn and you'll be right. It's that quick.

If you decide to wind up this plane with a lot of garbage out, such as gear and flaps, about the only real difference you'll note is the increased oscillation; the aircraft oscillates toward the horizon on the average of once per turn. This is especially true if you make the entry on the fast side. On the first turn the nose will tend to come up pretty high and then as you progress into the spin, a dampening effect occurs and every turn will find the nose lower. Of course center of gravity enters into the picture too. The further aft the CG, the higher the nose will ride for a while. In spite of this, recovery is the same as any spin and just as rapid. With dive brakes out rudder is not quite so effective.

Maybe you're wondering about the altitude loss in a spin. Actually that depends on configuration and altitude. At 25,000 feet, for example, with all the garbage in, you'll lose about 5000 feet or so in a two turn spin. This includes recovery. With gear and flaps extended you'll actually rotate faster and consequently the altitude loss per turn will be less. At lower altitudes the loss is almost cut in half, say from 15,000 or thereabouts.

I guess it's the same old question but someone always inquires about flat spins. Does the F-94C tend to get into flat spins? My answer is an emphatic NO. I've been able to force a flattening effect by crossing controls but the bird won't stay there long so we can scratch that problem. It doesn't exist.

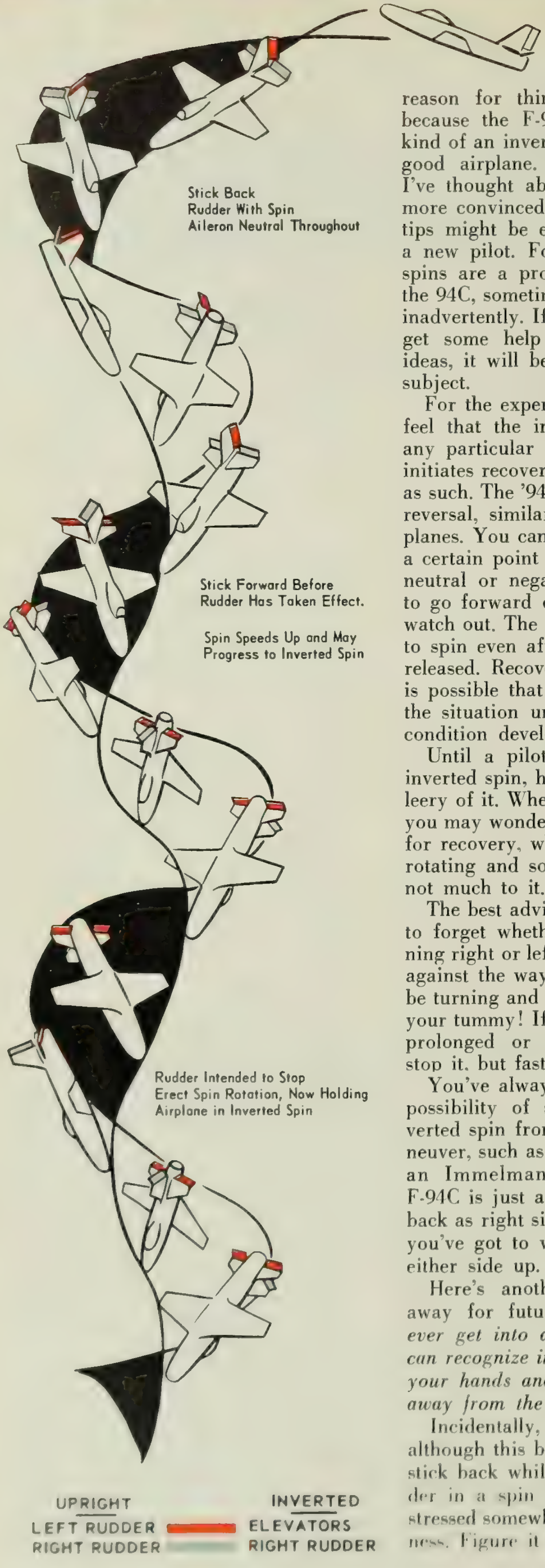
On the subject of asymmetrical configuration as related to spins, my advice on the F-94C is the same as with any airplane with an uneven wingtip loading. Don't spin 'em. If you do accidentally and recovery is not effected within a turn or two — drop the tanks. Cheap insurance!

When I first started to get my ideas on paper, I didn't intend to get into the subject of inverted spins. My

*Sammy Mason is particularly well qualified to discuss the F-94C spin characteristics for the simple reason he ran the tests. Incidentally he flew the T-33 spin tests, too, so probably he knows more about spinning these two Lockheed products than any other individual.*

*Sammy has been flying for 19 years and has piled up something over 8000 hours. His jet time is about 1500 hours and he got that in three years as test pilot for Lockheed.*

*As a member of the old Tex Rankin Air Show, Sammy has been known to make ladies faint and strong men shudder with his acrobatic maneuvers. Today, however, with 5 8/9 children, he is confining his flying activities to the more gentle art of testing the new blowtorches.*



reason for thinking this way was because the F-94C makes the same kind of an inverted spin as any other good airplane. However, the more I've thought about that subject, the more convinced I became that a few tips might be extremely valuable to a new pilot. For, although inverted spins are a prohibited maneuver in the 94C, sometimes a pilot enters one inadvertently. If any of you new boys get some help from the following ideas, it will be worth covering this subject.

For the experienced pilot I do not feel that the inverted spin presents any particular problem provided he initiates recovery upon recognizing it as such. The '94C does have a control reversal, similar to many other airplanes. You can work the stick up to a certain point where it will become neutral or negative. Then it'll want to go forward on you. At that point watch out. The airplane will continue to spin even after pressure has been released. Recovery is sluggish and it is possible that you could aggravate the situation until an uncontrollable condition developed.

Until a pilot has experienced an inverted spin, he'll probably be a bit leery of it. When the first one occurs you may wonder which rudder to use for recovery, which way the plane is rotating and so on. Actually, there's not much to it.

The best advice for the beginner is to forget whether the plane is spinning right or left. Merely push rudder against the way the plane *appears* to be turning and hold the stick back in your tummy! If the spin has not been prolonged or aggravated that will stop it, but fast.

You've always got to consider the possibility of slopping into an inverted spin from some acrobatic maneuver, such as stalling out on top of an Immelmann. Fortunately, the F-94C is just as spin resistant on its back as right side up and here again, you've got to work to make it spin, either side up.

Here's another thought to tuck away for future reference: *If you ever get into an inverted spin, you can recognize it at once because both your hands and feet will be pulling away from the controls.*

Incidentally, that is why I feel that although this business of holding the stick back while using recovery rudder in a spin may have been overstressed somewhat, it's still good business. Figure it out. Right side up or inverted, if you can just kick rudder against the apparent direction of rotation, the spin will stop and you can then complete the recovery from either type of spin, as the case may be. I say this because sometimes normal spins, in some planes, can get violent enough to fool the embryo pilot. I don't feel that this latter statement applies to the F 94C, but it's worth remembering.

That's about all I have to offer on inverted spins except this: Unless a new pilot has a few demonstrated while in flying school, the chances are good that he'll not recognize the fact when he suddenly goes from a right side up to an inverted spin. Here's the reason why:

For the sake of discussion let's say this pilot is making a normal spin to the right. Everything is going along okay until he starts the recovery. At this point he fouls up. Let's see what happens.

He applies left rudder against the spin but does not wait long enough for it to take effect. Before rotation stops he shoves the stick forward and is startled to note that the spin is speeding up. A split second later the aircraft goes into an inverted spin. Now, the rudder he was using to stop the erect spin is holding the plane in an inverted spin. Confusion reigns supreme!

If he doesn't get wise, but fast, he's going to run out of sky and luck at the same time. Maybe someone should have told him that he would feel the pull *away* from the controls in an inverted spin.

I would like to re-emphasize one point on erect spin recovery technique. It is really important *not* to use the stick ahead of the rudder, and personally I wouldn't use it simultaneously. If you do come in first with stick the aircraft may wind up for several turns before it wants to recover. The reason for this is that as you use forward stick pressure, you deflect the airflow in such a manner that it misses the rudder. And the rudder is the primary control for stopping the spin.

So keep the stick back until the opposite rudder is in and has taken effect.

I guess that's about all I have to cover on spins. If I've sounded like a primary instructor it wasn't intentional. However, I would like to leave you with this thought: Remember how you used to do snap rolls in light planes? This spin recovery procedure is just the same. ●

# ANYMOUSE and his hairy tales

IT'S a well known fact that every one of us learns something from every flight. Any day that you return from a hop into the blue and decide you've learned nothing new, that, brother, is the day you'd best turn in your wings.

So what does this lead to? Well, recently we've been watching a new program swing into action. It's a real deal, dreamed up by our sister service, the U.S. Navy. They call it the ANYMOUSE plan. And it's already starting to pay off.

Basically, the idea evolves around the theory that a close shave with the grim reaper will probably teach a guy *something*. If he can pass on a bit of this new knowledge to the next man, then both will benefit. But how to get this information in the mill?

There are very few intrepid souls floating around the area who willingly admit they've been dopes. Nevertheless, it's conceivable that some of the up-and-locked experiences could, if properly disseminated, prove of real aid to the next fellow.

Right here is where the anonymous report type of form can pay rich dividends. Admittedly the USAF doesn't have such a gimmick yet, at least not Air Force-wide, but it is worth thinking about. It's working well for the Navy and taking hold fast. Why not for us?

The USN encourages its pilots to submit narratives of near accidents or harrowing experiences. The idea is to allow pilots to remain anonymous and still encourage submission. Hence the "Anymouse" form.

It has been said that we learn only by experience. Probably this is quite true, but, if we can profit by close calls that happened to the *other* guy, then we've taken another step forward toward greater flying safety.

Most of you are familiar with old Grandpaw Pettibone. He usually selects a couple of real dillies from the Anymouse reports for his two-page spread in the *Naval Aviation News*. Needless to say, his pages are "must" reading for every pilot who gets hold of that splendid publication. And that goes for Air Force as well as Navy personnel.

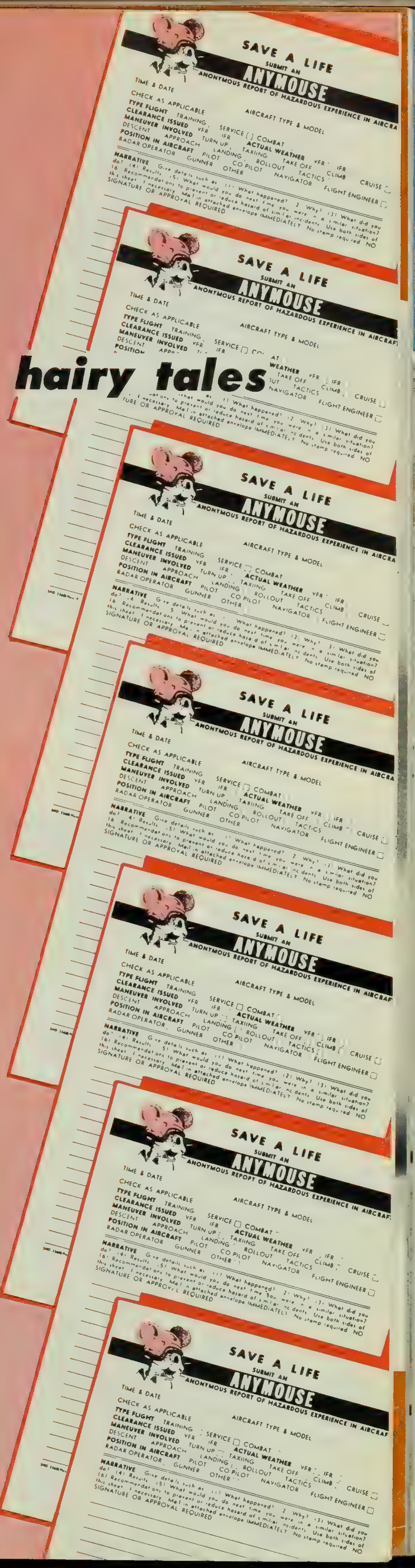
Just in case you've never seen the Anymouse form, we're reproducing a copy on this page. The Navy furnishes franked envelopes with each sheet, thereby eliminating the necessity for scrounging in your secretary's desk and, since they are self-addressed, they encourage submission of reports.

The thought has occurred that all Air Force organizations could well profit from a similar plan. In addition to unusual incidents, special emphasis should be placed on hazardous conditions encountered in flight. Also, unmarked obstructions, communications failure or breakdown, inadequate NOTAM service and allied subjects could prove extremely helpful for the next fellow.

Both SAC and MATS have a comprehensive incident report system which is utilized in their respective flying safety programs.

FLYING SAFETY would be tremendously interested in receiving comments on these systems or any new system created within the USAF.

As an interim measure, there's no reason why a comparable reporting plan cannot be worked out at group or wing level. You could do your own organization a lot of good that way, and any time an especially hairy tale showed up, we'd be very pleased to receive a copy. Might just fit in our program too. ●



SAVE A LIFE
SUBMIT AN
ANYMOUSE
ANONYMOUS REPORT OF HAZARDOUS EXPERIENCE IN AIRCRAF

TIME & DATE
CHECK AS APPLICABLE    AIRCRAFT TYPE & MODEL
TYPE FLIGHT TRAINING ☐ SERVICE ☐ COMBAT ☐
CLEARANCE ISSUED VFR ☐ IFR ☐    ACTUAL WEATHER VFR ☐ IFR ☐
MANEUVER INVOLVED TURN UP ☐ TAXIING ☐ TAKE OFF ☐ CLIMB ☐ CRUISE ☐
DESCENT ☐ APPROACH ☐ LANDING ☐ ROLLOUT ☐ TACTICS ☐
POSITION IN AIRCRAFT PILOT ☐ CO PILOT ☐ NAVIGATOR ☐ FLIGHT ENGINEER ☐
RADAR OPERATOR ☐ GUNNER ☐ OTHER ☐

**NARRATIVE** Give details such as (1) What happened? (2) Why? (3) What did you do? (4) Results (5) What would you do next time you were in a similar situation? (6) Recommendations to prevent or reduce hazard of similar incidents. Use both sides of this sheet if necessary. Mail in attached envelope IMMEDIATELY. No stamp required. NO SIGNATURE OR APPROVAL REQUIRED

Flying Safety
In Alaska
REVIEWED by
ME
Prepared by The Flying Safety Division, Office of the Inspector General, Headquarters Alaskan Air Command.
ME
ME
MAJ. GEN. G. A. ACHESON
ME

# "ME" for YOU!

IT ISN'T too often that we have an opportunity to hand a pat-on-the-back to a sister publication. However, having survived growing pains for a full year and still showing every indication of normal development, "ME" deserves a tip of the hat. And, that doesn't imply that this little squib is written in the first person.

"ME" is a very real magazine, developed by personnel within the Alaskan Air Command and aimed at the problems peculiar to that theatre. A few cover sheets are reproduced here and you'll note that they represent hard work and lots of talent.

As FLYING SAFETY personnel are well aware, it's a never-ending job to dig up good material for publication. It's a greater job to analyze each article, make sure of the facts, determine how each may be best presented and finally, examine all statements for Air Force policy (just the facts, ma'am).

One of the outstanding jobs being accomplished by "ME" is the constant hammering away at safety of flight aspects within the Alaskan theatre. This is no one-man job by any means. Everyone from the commander to

**An alert, aggressive flight safety program pays off for the Alaskan Air Command.**

the pilot gets in his two-bits worth through the medium of the magazine.

It's a case of come one, come all. The RO with the hairy tale or the crew chief with a new gimmick both get a chance to speak their piece in "ME." Just as long as the subject is slanted toward greater safety in the air or on the line, it's a welcome addition to each issue.

Unlike its stateside counterparts, "ME" is not blessed with modern printing plants or fancy reproduction aids of any sort. Instead, the Editor, A/1C Bill Johnson, has to bird-dog the copy, edit the material, cut the stencils and crank the duplimat machine by hand. Then, after breaking a few icicles off the stapler, he pounds 600 copies together. This we might add, is no small chore.

As if all this were not enough, the editor now doubles in brass and assumes the title of distribution manager, mushing his way from door to door, passing out copies to about a dozen different squadrons. We don't know for sure, of course, but we'll take bets that between issues he probably pulls KP and CQ.

One of Editor Johnson's biggest headaches came from the guardians of the purse strings. He wanted to use color inside the magazine. They said NO. It seemed like a losing battle at first until he hit upon the idea of using colored stock for the covers and vari-colored sheets inside. It worked, too. Now he has the color when needed. He still cranks out the publication with black ink and the whole magazine looks like a professional job any way you slice it.

You are apt to hear all manner of stories about arctic flying. How tough it is. How peculiar the climatic conditions are. How the pilot nicely coming in VFR finds himself blinded by ice fog within a matter of seconds. The accounts, the legends, even the misconceptions are legion.

Okay, a lot of this is true, but some of the tales are pure bunk. That's where "ME" comes into the picture and helps the newcomer a great deal. The magazine has been found the ideal medium to dispel some of the completely untrue tall stories that are thrown at the new arrival in the Territory. We all tend to fling the well-known bull a bit and sometimes such yarns can do a lot more harm than good. "ME" lays it on the line. The articles are handled in readable and, at the same time, meaningful language. What's more, they do not attempt to hide the moral; they blast it right out in the open.

The other helping hand on the staff of "ME" is Dr. Ira E. Chart, who is the official Historian for the Alaskan Air Command. To him, flight safety is a pleasant avocation — and, at the same time, a challenge.

With the approval and backing of the command inspector general, he and A/1C Johnson have teamed up together to make the magazine a living reality.

When one considers the flying conditions in the Alaskan theatre, the various types of terrain that must be taken into account and the "open air" maintenance that is carried on, then the real value of a good safety publication is readily recognized.

On the anniversary of the first year of publication, FLYING SAFETY extends a Happy Birthday to "ME." ●

# the BAD and the Beautiful

PILOT error caused 51 per cent of all USAF accidents in 1953. Obviously this figure is too high and should be lowered. This article, while outlining several accidents caused by pilot error, also relates contrasting incidents which illustrate how a pilot's knowledge of an aircraft and emergency procedures can cut this percentage to the minimum.

There is a right way and a wrong way to do almost everything, and this certainly applies to the operation of aircraft, particularly from a flying safety viewpoint. The accidents and incidents outlined here are examples of good and bad flying technique in similar types of aircraft. Notice that the outcome of each usually rested with the capabilities and knowledge of the pilot.

### Landing The T-6

The following two incidents are not exactly the same but both occurred in T-6s and at night. One illustrates good flying — one does not.

A student pilot was on a solo navigation mission when, approximately 15 minutes after takeoff at 8500 feet, the engine missed a few times and then quit. The pilot advanced the mixture control to full rich and shortly thereafter the engine restarted. Thinking that the difficulty had been over-leaning, the student re-established his heading and altitude. The engine soon began running rough and cutting out again. He then enriched the mixture, used carburetor heat, checked the primer and used the wobble pump. None of this had any effect and all instruments were checked and read normally. The pilot called the tower and made his difficulty known as he turned back toward the field. He maintained altitude although the engine ran rough intermittently. A power letdown was accomplished over the field and a close-in, 360-degree overhead approach was made. On the 800-foot base leg when the pilot closed the throttle the engine cut out completely. The student then made a successful, gear - down, dead - stick landing.

Weather data indicated that carburetor ice was not the cause of the engine failure but that there was an internal malfunction of the carburetor. Knowledge of emergency procedures and traffic pattern enabled this student to land safely and avert a possible accident.

Unfortunately, such is not always the case. Often, when there is not even an emergency, accidents occur. For example, this pilot was making his first night approach. The IP had instructed him to make a no-flap landing.

He turned on final and was gliding at 90 mph indicated with no flaps. Runway Control gave him a green light, indicating that his gear had been checked and he was clear to land. After turning on his landing lights it was apparent to both the student and the instructor that they were too low and short of the runway. Both pilots applied power simultaneously which caused over-control of the throttle and the engine did not respond readily. The IP observed trees on his left and thought that if he could avoid hitting them he could land safely within the field boundary. At this point the engine responded to the application of the throttle and the aircraft started to climb. Almost immediately the right wing struck a tree which was 1200 feet from the end of the runway and 52 feet above the surface.

The aircraft rolled to the right and semi-cartwheeled in the air until the nose was almost straight down. The IP then applied full back stick and right rudder causing the plane to snaproll around to the right. The left wing and side of the aircraft struck the ground after turning approximately 210 degrees from the original heading. The main gear was sheared on impact and the plane skidded backward on its belly and stopped. Although fire broke out on impact, both pilots evacuated without injury. The primary cause of this accident was that the instructor pilot allowed the student to make a flat, low approach on his first night landing. In addition, the IP waited too long to make a correction and then applied the wrong control movements.

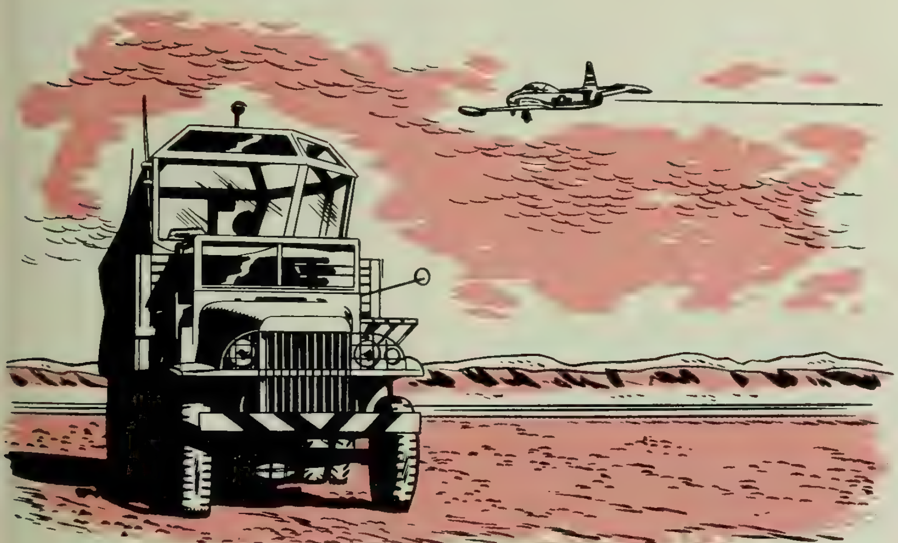
### Jet Trainers, Too

Jet trainers also have their "moments of decision." The pilot of a T-33 established a low speed letdown. When the landing gear was extended, the left main indicator did not indicate in the green. The light functioned properly when push tested and hydraulic pressure was normal. The pilot had experienced previous difficulty with the landing gear microswitches and believed this to be the cause of his trouble. The letdown was continued with a GCA pickup. When the GCA was almost completed the run was broken off and a low pass was made over the tower to check the position of the gear. At first the tower reported that the gear appeared down. However, on a subsequent pass it was reported that the left main gear seemed to toe-in. With this information the pilot cycled the gear several times but could not get a down and locked indication. Side slipping and G forces were tried with no success. With fuel low, the pilot chose to drop his tiptanks and proceed with the landing. When touchdown was made he bounced the aircraft on the right gear and landed with a slight crab to the left, causing outward pressure on the left gear. This forced the gear into the locked position. The pilot executed a go-around and landed without incident.

Inspection revealed that the upper part of the left landing gear fairing door had come loose, binding on the under side of the wing and not allowing the left landing gear to extend fully. The pressure put on this fairing by landing in a slight crab caused it to give, allowing the landing gear to go into the locked position. This pilot exhibited ingenuity and forethought in averting a possible accident.

Another pilot in a T-33 found himself in almost similar circumstances when he found that his right gear would not lower. He attempted to cycle the gear several times and made a pass over the Mobile Control Unit to check the position of the gear. Mobile Control reported the nosegear and left gear down but the right gear still up. No attempt was made to use the emergency landing gear system. Instead, the pilot elected to make a wheels-up, belly landing and did so without injury to himself.

The primary cause of this accident was found to be the failure of the pilot to use emergency procedures. The emergency system was tested after the accident and was found to operate satisfactorily.



## Sabre Sorties

An F-86F was on a routine flight at 35,000 feet when a severe engine surge occurred as the pilot advanced the throttle from 80 to 100 per cent. He attempted to retard the throttle from full open to preclude the possibility of an over-heat temperature condition; but was unable to prevent a tailpipe temperature rise to 850 degrees. At this instant a slight explosion occurred, followed by an immediate flameout.

The pilot stop-cocked the throttle and began a descent to 25,000 feet. There he tried an airstart on the normal fuel system and was unsuccessful. At 22,000 feet he attempted an airstart on the emergency fuel system with negative results. To eliminate the possibility of a procedure error, he contacted another aircraft in the area to talk him through an airstart, but again it failed.

He previously had contacted the tower and informed them of his difficulties. With the aid of the radio compass the pilot determined an approximate bearing and distance to the field by tuning several local radio beam homers. Then, at 19,000 feet he turned off his battery to conserve electricity. A solid overcast was entered at 16,000 feet.

By dead reckoning, he made a high speed letdown toward the field. The aircraft broke out at 2500 feet about two miles north of the field, indicating 350 knots. The pilot turned on the radio and attempted to contact the tower to give his position as well as request the surface winds. However, because of the weak battery, the radio failed to channelize. With the aid of the excess speed he set up a pattern and, as soon as possible, lowered gear and flaps. He turned on final at 1500 feet, extended speed brakes and, because of windshield frost, opened the canopy for visibility. A gear check revealed an unsafe nosegear condition and the emergency landing gear release handle was pulled. Immediately upon touchdown, the nosegear was lowered and the stick trimmed full forward to get maximum braking action. A series of rapid, hard braking actions stopped the aircraft about 500 feet from the far end of the runway.

Subsequent investigation of the aircraft showed a faulty main fuel regulator. The airstarts were not successful because of a short in the emergency ignition switch. The pilot had only about 500 total flying hours at the time of the incident.

While in a formation at 8000 feet, the pilot of another F-86F heard a roaring sound which he thought to be air. Shortly thereafter, he noticed an unsafe condition on his landing gear position indicators. He attempted to call his flight leader but found his radio inoperative. He reduced power and opened his speed brakes to slow the aircraft enough to permit cycling of the landing gear. The throttle was then retarded to the IDLE position with the aircraft responding only gradually. The rpm dropped slowly to 80 per cent and stopped momentarily. While the pilot tried to lower the gear the rpm dropped to 65 per cent. He then lowered the nose and advanced the throttle to see if he had control of the engine rpm. The engine speed picked up to 80 per cent and remained there.

Deciding to land at once, the pilot entered the initial and made a normal break for a runway using left hand traffic. He was unable to slow the aircraft below 200 knots on the final approach. A low pass was made over the runway. The control tower gave him a red light because of an aircraft parked on the approach end of the runway.

The pilot made a right hand turn at the airfield boundary following the first pass and then flew a rectangular pattern with a right turn onto base leg and final. He did not make an initial on his second pattern although his airspeed was the same as on his first approach — 200 knots. His speed brakes were in, his flaps up and his gear full up. Two pilots in Mobile Control as well as the control tower operators were of the opinion that this, too, would be a go-around, due to the clean configuration of the aircraft. This accounts for the Mobile Control Officer not firing a flare. The operators in the control tower stated that they did give the pilot another red light which was unheeded.

The pilot brought the throttle around to IDLE stop, moved it forward, and then slammed it back in an effort to stop-cock the engine. The aircraft touched down on two empty 200-gallon external fuel tanks about halfway down the runway and skipped slightly. During this skip, the pilot ejected the canopy. The aircraft touched down again about 250 feet from the end of the runway and slid to a stop some 400 feet past the end.

During the subsequent investigation, it was found that the pilot:

- Failed to recognize the need for, and made no attempt to use the generator reset procedure.
- Failed to place the throttle in the stop-cock position when landing in order to shut off the fuel.
- Failed to use emergency procedure for manual lowering of the landing gear during electrical failure.
- Permitted panic to overcome good judgment and in doing so, neglected to use any emergency procedures which could have averted this accident.

### Enter The F-94

Often, emergency situations arise which serve to demonstrate superior flying ability of a particular pilot. However, some pilots seem to take the emergency along when they climb into a cockpit.

Below is the statement of one pilot who knew how to handle an emergency:

"I took off in an F-94C to make a visual check of another aircraft which had inadvertently collided with some object immediately after breaking ground. I found nothing wrong with the empennage of the other aircraft and returned to the field for landing.

"Five miles from the base at an altitude of 3000 feet and an airspeed of 300 knots, the tail section warning light, emergency fuel light and fuel pump failure light all came on. I checked the instruments which showed the tailpipe temperature surging from 700 to 1000°C., and the engine rpm increased to 104 per cent. I immediately retarded the throttle but this did not alleviate the situation so I stopcocked the throttle and set up a pattern for the nearest runway.

"The control tower was slow in turning on the lights of the chosen runway but I knew the field and the local area, and continued the flameout, night approach. The runway was illuminated when I was two miles out on final. I lowered the gear and flaps when I saw I had the field made and touched down at 150 knots in the first thousand feet of the runway. I used the drag chute and completed the landing without further incident."

The pilot quoted above exhibited skill and calmness in completing a successful, night, deadstick landing under adverse conditions.

Yet, some pilots manage to mess up landings when nothing abnormal occurs. For example, take the pilot who returned to the base for landing after accomplishing an air defense mission with no apparent difficulty.

This F-94C was flown in a normal initial and traffic pattern to final approach. On final a combination of a flatter than normal approach attitude, too low an airspeed and a slightly gusty crosswind caused the aircraft to strike the ground approximately 150 feet short of the runway. It then bounced into the air and touched down again on the runway, nosegear first. The aircraft then began a porpoising action which resulted in the collapse of the nosegear and bending of the main gear. The aircraft then rolled about three or four thousand feet down the runway before veering sharply to the left and rolling off into the grass. This veer was caused by the left tire binding against the left strut. The pilot and radar observer escaped without injury when the aircraft came to a complete stop. There was no fire.

The investigation board concluded that the pilot displayed improper pilot technique during the landing phase of the flight and that he failed to recover properly after a short landing, a bounce and the resulting porpoising action.

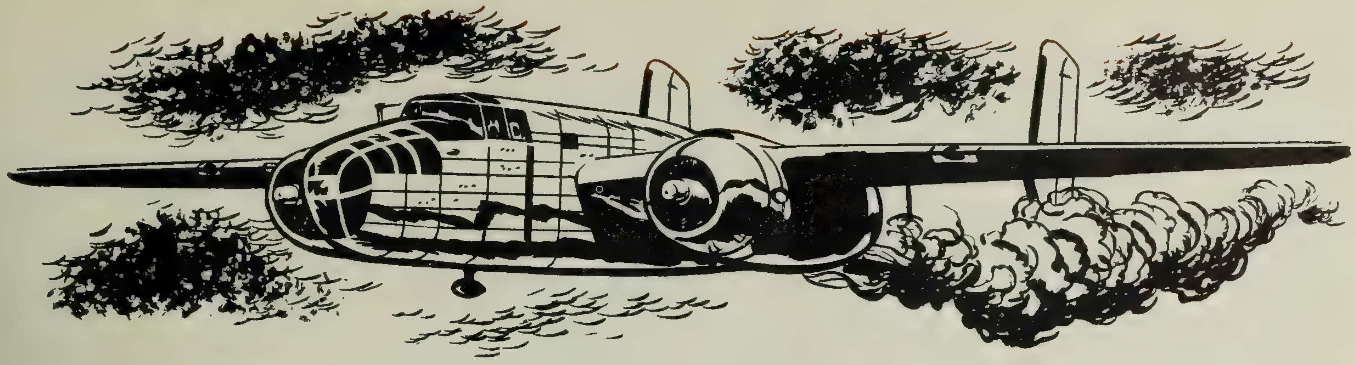
### B-25 Emergencies

A B-25J was the target aircraft on a routine night radar mission. After about three hours of flight without incident while some 50 miles southwest of the base, landing lights were turned on to alert the fighter crew of an approaching flight. When the lights were turned off the left one continued to burn. The pilot toggled the light switch several times in an unsuccessful attempt to extinguish the light. It surged to extreme brightness, flickered, burned dim and then went out.

The pilot and copilot simultaneously detected burning fumes and noticed excessive grey-white smoke pouring from the left wing root. The pilot immediately turned off the battery, navigation lights and radio switches. As he was telling the copilot to turn off the generators and inverter in the upper turret compartment, a severe yaw was experienced. The left engine manifold pressure surged and there was a complete loss of power in the left engine. Single engine procedure was performed but the engine failed to feather.

At this time smoke was so thick in the pilot's compartment that neither pilot was able to breathe normally and they had difficulty keeping their eyes open. In order to read the instruments, the copilot had to hold a flashlight within six inches of the panel. All cockpit light switches, including the fluorescent lights were placed in the OFF position. The two men checked their parachutes but elected to wait a "reasonable length of time" before leaving the plane.

As the smoke began to clear from



the cockpit, more attempts were made to feather the prop but to no avail. Smoke intermittently filled the compartment during the return to the base. The pilot briefed the copilot on gear and flap lowering procedures, for all the indicators and the horn were inoperative. Hydraulic pressure was normal.

The plan was to land on active runway, if traffic permitted, or to the east of the runway on the grass should there be some obstruction. About five miles from the base, a letdown to 1500 feet indicated was made. The aircraft was then about two miles from touchdown and good visibility on the initial, base and final approaches was made possible by entering slightly below pattern altitude. Gear was lowered by the copilot and checked visually about a mile and a half from touchdown. When hydraulic pressure returned to normal, one-half flaps were lowered about three-quarters of a mile from touchdown by using the counting method. An uneventful blackout landing was made on the first third of the runway and the aircraft was turned off the runway, engine cut and brakes set. The crew abandoned the aircraft.

The investigation revealed that the left landing light relay switch had stuck, causing it to overheat. The resulting short and burning insulation burned all other wires in the junction box in the left engine and the conduit in the left wing root. The engine would not feather as the wires to the feathering motor were burned.

Unfortunately, all pilots do not recognize such emergency situations quickly enough to deal with them adequately. In the following accident the pilot, copilot and crew chief were all highly experienced personnel.

The B-25J was on a local test flight after a major inspection and number one engine change. Preflight and engine runup checks revealed no discrepancies. Takeoff was normal and the aircraft climbed to 10,000 feet. Test flight checks using the check sheet proceeded normally as the aircraft was flown in the local area until the number one engine was feathered. The prop feathered normally and was unfeathered after about a minute at which time it overspeeded to approximately 3000 rpm with the propeller control in low rpm position and the throttle retarded. Several attempts were made to feather, and to control the prop, none of which had any effect.

The engine was cut off and the prop continued to windmill at about 2300 rpm. The aircraft started losing altitude slowly while being flown back to the base. The pilot declared an emergency about two miles from the field at 7000 feet.

The aircraft was flown over the base where loss of altitude indicated the necessity to land immediately and a pattern was set up. Further loss of altitude required abbreviating the pattern and lining up with a different runway. As the turn on to final was made, the gear was started down but was retracted immediately when it was determined that the runway could not be made with the gear down. A decision was made to land on a dry lake bed one mile east of the base.

The B-25J was rolled out of the turn and held level, power was cut on the number two engine and the aircraft touched down tail first. The landing was smooth with no rebound. The right engine touched slightly ahead of the left. The aircraft slid 528 feet to a stop, rotating about 45 degrees to the right. No fire occurred and no injuries were sustained.

Of course, the primary cause of this accident was the malfunction of the prop governor on the number one engine. However, a contributing cause lies in the failure of the pilot to use proper judgment in recognizing this emergency in sufficient time to attempt a landing while he had adequate altitude over the airfield.

## B-45 Complications

The B-45A was in a descent at an airspeed in excess of 400 mph when the left main gear uplock failed. Severe vibration and a violent bank to the left was accompanied by a loud noise. Immediate stability and control of the aircraft were momentarily lost. With a reduction of power control was regained. Visual inspection indicated that the left main gear had extended and had swung past the full down and locked position. All efforts to retract the gear failed. Due to broken lines, all hydraulic fluid was lost. Because of the position of the gear the navigator was unable to bail out so the decision was made to crash land.

Weather at the base was reported as 600 feet overcast — visibility one and one-quarter miles in fog. While lowering the nose and right main gear during the descent the weather had deteriorated still more and darkness had closed in. The fuel supply was diminishing because of the low altitude operation during the emergency procedures.

GCA was contacted and an approach established to land on a 9000-foot runway. The aircraft broke out of the overcast directly on the center line of the runway at about 300 feet. Touchdown was made 2000 feet down

the strip and the aircraft came to rest 4000 feet from the point of touchdown, 300 feet to the left of the runway. No flaps were used during the landing.

The board concluded that the failure of the left main gear was caused by one or a combination of the following:

- Malfunction or improper adjustment of the left gear uplock mechanism.
- Failure of the retract cylinder mounting lug casting on the left gear.
- Possible adjustment of the landing gear door uplock mechanism.

However, the ability of the aircraft commander to accomplish the crash landing under extremely adverse weather conditions resulted in a minimum amount of damage to the aircraft and no injuries to the crew.

FLYING SAFETY believes this pilot displayed outstanding flying technique. His knowledge of the aircraft combined with cool, quick thinking averted a major accident under emergency conditions compounded by bad weather.

### Even The Gooney

The Gooney Bird was on a scheduled over-water navigational training flight. The crew and passengers had received overseas briefing and a refueling stop had been made without incident. Almost two hours after takeoff, the right engine started losing oil pressure. A check of other instruments revealed no increase in oil or cylinder head temperature. The pilot and copilot acknowledged the possibility of a faulty oil pressure gage, but maintained a close watch on all instruments. The pilot requested exact position and distance to destination from the navigator and the crew chief was sent for a visual inspection of the right engine.

Shortly thereafter, the right engine ran away and no corrective action seemed to help. The order was given to feather and a single engine operation was set up. Considerable difficulty was had in feathering the engine and three cycles were necessary.

A course was set up for the nearest landing strip and the details of the emergency were relayed to nearby radio stations to alert Air Sea Rescue and D/F stations. All passengers were briefed on the emergency and a check was made of all personal and survival equipment.

The weather was broken undercast at 3000 feet with occasional build-ups to 9000 feet. Moderate to severe turbulence was encountered. With 35″ and 2400 rpm setting, 95 mph could be maintained and altitude held, but the good engine heated to 250 degrees cylinder head temperature. Emergency rich mixture had to be applied to bring it down to 220 degrees. As some of the fuel burned, the airspeed picked up to 100 and then to 105.

The radio operator reported that the D/F stations had the aircraft located and a rescue plane was on its way to the position. The navigator checked and rechecked the course which later proved to be "right on the nose." When the new destination was reached, no ditching could be attempted as poor visibility kept the pilot from distinguishing water from land. All personnel were briefed and prepared for bailout in case conditions got worse.

To further complicate matters, the charts indicated a 4900-foot runway, but the tower reported the first 1100 feet under construction. Altitude of 700 feet was maintained until the aircraft was directly over the field. Everyone was strapped in tight and the letdown was begun. A perfect approach and smooth landing were made. The C-47 had flown two hours and 20 minutes after the right engine had failed.

### And Then There Are These

This C-47 entered the traffic pattern in a normal fashion. The checklist was used and both engines were operating satisfactorily. Approximately one half a mile from the runway at 400 feet the left engine began backfiring. Airspeed was between 100 and 105 mph and flaps were full down.

The pilot advanced the throttles and although the right engine responded, he did not believe he could make the runway. He immediately raised the gear but did not raise the flaps to an intermediate position. At this time the aircraft was slightly off to the left of the runway. The copilot and engineer thought the left engine began developing power. Both called "Let's go around." An attempt was made to go around but altitude could not be maintained. The course was altered to the left to avoid hitting a small building and a crash landing was made.

The tailwheel touched down 1500 feet down the active runway and 425 feet to the left. The aircraft stopped after the right tire blew out and the aircraft made a 90-degree turn to the right. Point of touchdown to point of stop was 600 feet.

The investigation board found that the pilot did not follow prescribed procedures for the failure of an engine in flight. He did not feather the left engine, raise the flaps to a position where they would create more lift than drag, use the proper amount of power from the right engine to maintain control and lost directional control. The pilot indicated a lack of knowledge of aircraft performance during single engine operation.

Obviously pilot error causes accidents. And just as obviously pilot effort can prevent an accident or keep one from becoming serious. Make sure yours is an effort not an error. ●

# when GLARE is there...

**Captain D. L. Cooper, FSO, Hq Sq 6612th AB Gp, Thule AB**

THOSE who should know claim that one way to achieve fame in this highly competitive world is to build a better mousetrap, or a variation thereof. Lately, USAF pilots have been exposed to a wide variety of these mousetraps in the form of new eye shields and hoods for instrument practice. Some of them were simple, some complex; all of them had many good points. But the pilots at Thule Air Base believe they have been given one of the better mousetraps.

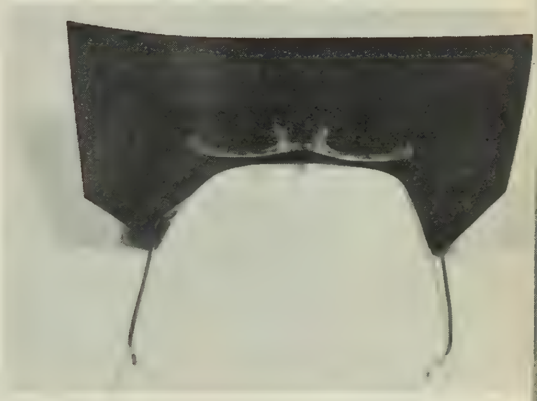
Any pilot who has ever flown into the sun has at one time or another placed his hand before his eyes. With a slight adjustment of his hand, this squinting pilot probably picked up a few minutes of instruments without using a shield or hood. It stands to reason that if one hand can cut down outside glare, something a little larger could restrict vision to the inside of the cockpit, provided that this something is close enough to the eyes.

Up here in the land of the midnight sun and arctic glare, Capt. Vernon W. Fisher, formerly of the 6612th Air Base Squadron, became tired of flying with one hand. He was aware of the problems that the present shields and goggles presented; of their bulkiness and weight, and the steam and fog they generate when a pilot is sweating it out. He decided to find out just how small and light an effective instrument shield could be. And up here he had 24 hours of sunlight everyday to further his quest for suitable materials.

His search took him to the base hospital. There he noticed that the operator of the X-ray machine occasionally over-exposed the film when things got busy. This ruined film was both light and dark; lightweight and dark colored, that is. Proper size and shape were taken care of with a pair of scissors.

Captain Fisher's next problem was how to mount the shield. In the Arctic, where the continuous sunlight on the snow during the summer months produces a terrific glare, dark glasses are a must. Fisher mounted his first shield on the arctic glasses issued each pilot. He then designed a second shield which can be used when there is no glare and conditions are normal. This shield is mounted on a lensless set of frames or over your regular glasses, if you use cheaters to tool around the countryside.

Captain Fisher passed some of his better mousetraps around among the pilots at Thule to get their reactions to the shield's weight and air circulation. The boys bought the idea completely; the whole contraption weighs only four ounces and is no more uncomfortable than any other pair of glasses. Air circulation is free and complete since the shield is worn in the same way as are any pair of glasses. It can be worn with a headset, crash helmet or a ball cap for long periods without the feeling of weight so common to the larger shields.



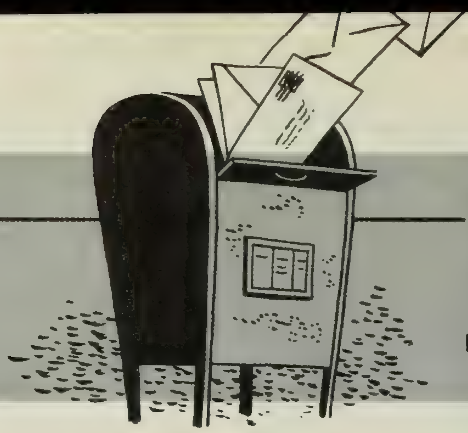
Frames and X-ray film make ideal glare shield.

The shield, as illustrated in the story, is particularly adapted to instrument flying in a B-25, C-47, C-54 or a T-29. For use in a B-29, B-50, C-46 or B-36, it may have to be modified to compensate for the lower windows in the sides of those aircraft.

Directions for making a shield for your use are as follows:

- Take a piece of over-exposed X-ray film and cut and bend it to the desired size and shape.
- Cut two slits on either side and insert the earpieces of your glasses or empty frames.
- Get in an iron bird, with someone to safe-observe you, and take off on one each instrument flight.

We here at the top of the world think we have found a better instrument shield. So, some evening, "when the dogs are fed and the stars overhead are dancing heel and toe," why not give it a try? We did, and can guarantee it works. ●



# CROSS FEED

## LETTERS TO THE EDITOR

### GCA Capabilities

In your February issue a very interesting article was published under "Keep Current" and credited to AACS, discussing the merits of GCA. This article stated in part, "GCA is capable of controlling any type aircraft to touchdown dependent only on the proficiency of the pilot and radar operator." The USAF Instrument Pilot Instructor School is of the opinion that we are building false security in the minds of inexperienced pilots charged with operating first line aircraft. Our opinion is based on several facts derived from active participation in over 1000 GCA runs per month at Moody AFB.

1. Some jet aircraft are easily lost on both search and precision radar scopes during moderate to heavy precipitation.

2. Considering a time lag of five seconds between an accurate observation by a controller and subsequent correction applied by a competent pilot, an aircraft at average approach speed will travel approximately 800 feet forward and 50 feet down. This is sufficient vertical and horizontal velocity to make quite a dent in the sod.

3. No mention is made of the probability of stopping the aircraft safely after touchdown.

We have utmost respect for AACS and GCA but we also have respect and an obligation to the people responsible for writing our regulations. The implication that a pilot may merely call GCA and then safely land the aircraft under any weather conditions is erroneous. A pilot and controller combination possessing the skill and judgment necessary for a weather approach and touchdown would be an extreme rarity. Are we facing facts?

Although we are progressing toward our goal of an all-weather Air Force, we are still somewhat removed from the era of "approaches to touchdown" whether it be automatic or pilot controlled. We recommend using available facilities to the full extent of their capabilities, but let's not gamble with government money. Aircrews and aircraft are expensive.

**Col. Dean Davenport**
**Commander, 3550th FTG**
**Moody AFB, Ga.**

*Colonel Davenport's point is well taken. FLYING SAFETY did not mean to imply that a pilot could land safely under any weather conditions merely by calling for a GCA run. We wished to show that a pilot can make practice runs below minimums, and, under emergency conditions, should utilize GCA capabilities to the fullest extent of his ability to fly instruments safely.*

★ ★ ★

### Request from Canada

We have read with considerable interest the article "Foul Winds at Fairweather" that appeared in the January 1954 issue of *Flying Safety*.

This article would be of considerable interest to our forecasters, especially those serving flights in the West Coast area, as well as to Canadian Pacific Lines and the RCAF in their West Coast operations.

I would be grateful if you would advise whether it would be in order for us to reproduce copies of this article for distribution to our forecast offices, Canadian Pacific Air Lines, and the Royal Canadian Air Force. Full acknowledgment of source and permission would, of course, be given on the reprint.

**Andrew Thomson, Controller**
**Air Services Meteorological Div**
**Department of Transport**
**Toronto, Ontario, Canada**

*Good idea. Let's spread the word.*

★ ★ ★

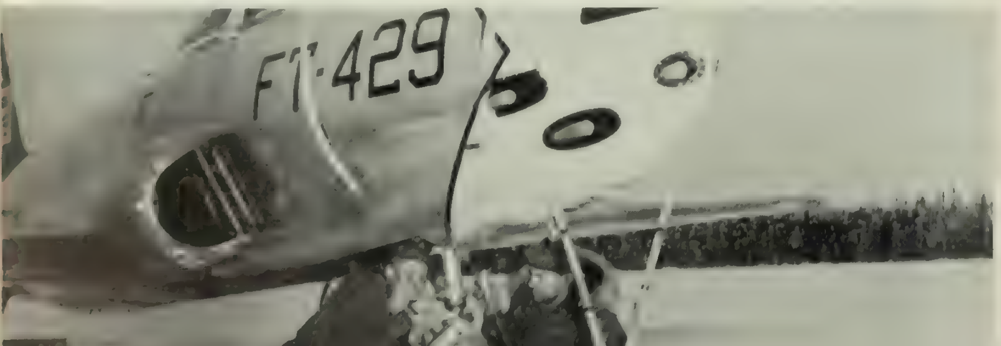
### Ground Safety Device

This unit of the Washington ANG has maintained a perfect ground safety record since reorganization from active duty, 1 May 1952.

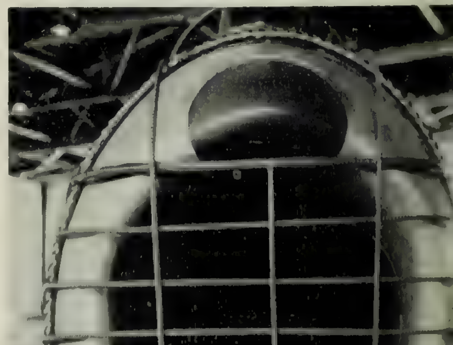
Here is a picture of an F-86A nose cover, built and used by this outfit for high speed ground operation of jet engines. We are sending this to you in the hope that you can use it in FLYING SAFETY and help other units with a similar problem.

**Capt. Charles L. Nelson, Jr**
**CO, 116th Ftr-Int Sqdn**
**Washington ANG, Geiger Fld, Wn.**

Lt. Colonel William Benedict made a successful take-off and landing in this ski-equipped F-80. The '80, which crashed in Alaska, was repaired but could only be flown out on skis, using jato.



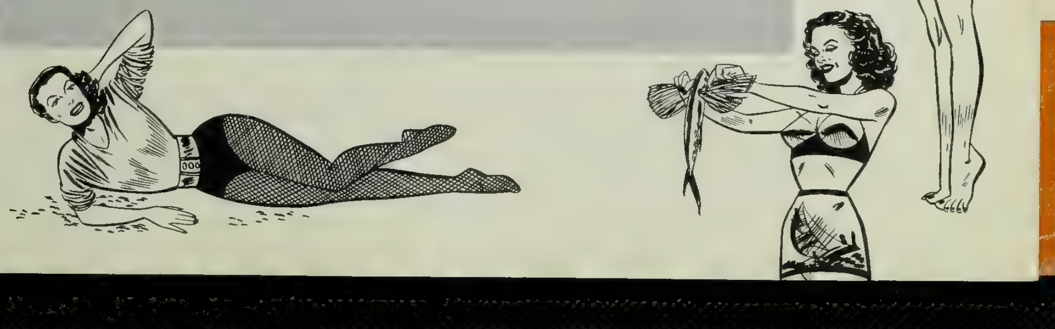
This F-86 nose guard was designed by a unit for use during high speed ground operation.



# Any Mouse Will Do....

In the spring a young man's fancy wanders through strange and wondrous channels. This month, FLYING SAFETY comes to the male animal's assistance with a bevy of beauties a la Steve Hotch.

In a more serious vein, the Anymouse program as outlined on page 19 deserves serious consideration from all commanders and flying safety officers. As a part of an accident prevention program, incident reports, either signed or anonymous, have a tremendous educational value. Other pilots can profit by your mistakes if you make a full, honest report of the incident, and if it is too hairy, just sign it ANYMOUSE.



# Mal Function

Mal has cold, treats himself
Lots of medicine from the shelf.

Sick call line is just for dopes,
Mal's not grounded, he knows ropes.

At 35,000, pills work magic
End result will be quite tragic.

Mal comes down, but things seem hazy,
Eardrums pop, plane acts crazy.

No more flying for this lad,
Wings not issued by old Dad.

★ U. S. GOVERNMENT PRINTING OFFICE . . . 271148

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JUNE 1954

# FLYING SAFETY

UNITED STATES AIR FORCE

World's Fastest Sled Ride . . . see page two

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Col. Stapp rides the rails at 421 mph, pg 2.

## SUBSCRIPTIONS

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* * *

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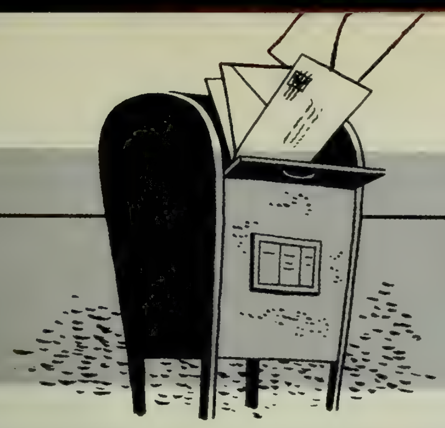


# CROSS FEED

## LETTERS TO THE EDITOR

### Fitting Your Chute

The article "If the Chute Fits" appearing in the March 1954 issue of FLYING SAFETY has been reviewed by this Center. Following are quotations from the article with applicable comments:

- "Put the harness on. Fasten the chest and leg straps. Tighten the leg straps in back." (Step "C" in fitting your Class III harness.)

NOTE: The sentence "Tighten the leg straps in back" confuses the reader since there are no leg straps in back. Assuming this to be an error in proof reading, the omission of the words "in back" would make the sentence appropriate to the recommended procedure. However, omission of the word "leg" would lead the reader to a highly undesirable procedure.

- "Reset index number and re-tighten back strap." (Last sentence in Step "D" in fitting harness.)

NOTE: Here the reader is led to tightening the back straps prior to Step "F" which tightens the leg straps. This results in malpositioning of the mainsling.

- It is recommended that the "Steps in Fitting Your Class III Harness" read as follows:

Prefit your harness to your sling length by setting to proper number. Set the index number by turning the quick-fit adapter on the sling 90 degrees to the webbing and pull until your number shows.

| *Height* | *Index Number* |
|---|---|
| Up to 5′ 6″ | 7 |
| 5′ 6″ to 6′ 0″ | 6 |
| Over 6′ 0″ | 5 |

- Tuck excess webbing into elastic keepers. Loosen back straps to insure that you will be able to get sling under buttocks.
- Put the harness on. Fasten the chest and leg straps.
- Slide chest strap up or down the sling to the proper distance below your chin. (12″ below chin.)
- Tighten leg straps by pulling down on loose ends.
- Adjust and tighten chest straps.
- Tighten back straps.

After fitting, loosen leg and chest straps by merely turning the quick-fit hardware 90 degrees and pulling gently, making yourself comfortable. Tightening again requires only a few seconds.

The Class III harness will fit men 5′ 2″ and 110 pounds, to men 6′ 4″ and 240 pounds, wearing heavy Arctic clothing.

Canopy release should be below collarbone. If it is any place else, your harness is not adjusted properly. Loosen back strap again. Reset index number and re-tighten back strap.

**Parachute Branch, Equipment Lab**
**Wright Air Development Center**

*Thanks for your letter of explanation. Such clarity is appreciated. FLYING SAFETY trusts the revised T.O. will be as clear.*

★ ★ ★

### Letter to Steve

For some time now I have admired your work in FLYING SAFETY.

Congratulations on doing a superior job!

**Cordially,**
**Milton Caniff**
**New City, Rockland Co**
**New York**

P.S. Why don't you sign your full name — Steve Hotch — and more readably?

★ ★ ★

### More On Foamite

"Captain E. J. Slown of the 61st Fighter Interceptor Squadron, APO 864, was on a local flight in a T-33 type aircraft, when on takeoff the nose gear selsyn indicator showed an unsafe condition. A low approach was made past the tower and the pilot was advised that the nose gear doors were open. Lt. Col. Max Wolfson, Commander of the 61st, upon returning from a mission accomplished a fly by and verified this information.

It was also determined at this time that the nose gear was cocked at approximately a 10-degree angle. An emergency was declared and the pilot elected to make a landing. Coordination was effected with Base Operations and the Crash Fire Department. Foamite was spread approximately six feet wide on the landing runway. A long final was flown aligning the aircraft with the foamite on the runway in order that the nosewheel would touch down upon the slick surface. Touchdown was made and the nosewheel held off until aircraft was over the foamite. Brakes were used to maintain directional control. The aircraft was brought to a complete stop, without damage. The pilot was commended by his Squadron Commander for his skill and ability."

**Capt. Raymond G. Summy**
**FSO Base Ops Div**
**Ernest Harmon AFB, NEAC**

★ ★ ★

### LINK Speaks

I have just read the articles in the March issue of FLYING SAFETY, one showing our B-47 Simulator and the other an article entitled, "Old Link, New Look," by Sgts. Wood and Hickman of Edwards AFB, Calif. Needless to say, they are of interest to us and appear to be very well done.

I wonder if it would be possible for us to receive an additional copy or two from your organization. I note that back copies are not available from the Government Printing Office.

**Lloyd L. Kelly, Gen. Sales Mgr.**
**LINK Av'n, Inc., Binghamton, N.Y.**

*Sgts. Wood and Hickman rate the kudos; mags are on the way.*

Final adjustments to safety harness are made prior to record run.

# WHOOOOOOSSH!

YOU don't have much time to think. Never thought it would happen to you. Doesn't seem real, even now. Hurry, hurry! Hey, take it easy, boy. Let's see. Oh yeah, get that mike and oxygen line off. Okay, everything is ready. Squeeze it!

There's a rushing, roaring sound. You can almost see the noise as a million fingers pluck at your body. Dammit. You forgot the visor. Better step it up, lad. Come on get with it. Then you clamp down on the right trigger. Your tailbone slaps the cushion. Ka-whoom! You can't see 'em but you can feel your legs driven down and then up! All of a sudden you're a projectile. Up, up, up and over, and away.

The next couple seconds are still hazy. Who knows up from down? This is funny though. You can feel the tumbling gyrations and then all the forces are gone and you are floating. Now it's almost quiet. Aw, this whole thing is screwy. There's the ground over your head. Or, it was anyway. What is this, a game? Hey! The belt. Get it off. Open it, open it. Come on, kick away from that seat, do it right now!

You squirm and elbow away. Hurry, hurry, hurry. The ground is coming. Grab the ring. There it is—now, pull! There's another neck-snapping jolt. Your body does a 180 in a split second and the right riser whaps your helmet. You wonder how it stayed on anyway. The second jolt is worse. It hurts this time. Quick, slashing pain that tears your guts. Okay, smarty, now you know why they say, "keep those leg straps tight." Well, it's too late for this round but if you ever get a second chance, that harness is *really* going to fit.

It's routine now. You watch some trees jumping toward you and then there's that one last whapp! and you're down. No future in this racket, you think. Maybe it's okay but why play it like a sucker? Who-e-e-e! You let your breath out and stretch out flat. That was just too close.

Maybe that won't be your impression of a high-speed bailout. Possibly you will have figured all of the angles in advance. Maybe it will be worse than that. After all, when the old Mach meter is sitting on the plus side, *anything* can happen. After all, who knows?

Well, there's one small group of individuals within the Air Force who know pretty well what will happen during a high-speed ejection. It's true that all of the answers are not completely firm, yet, but soon they will be.

Col. Stapp starts on the fastest ride that man has ever taken while still on the ground, propelled by six rockets generating 27,000 pounds of thrust.

## A small group of scientists at Holloman AFB are using a rocket sled to determine tolerances to deceleration, windblast and tumbling, following a high speed ejection.

Ever since the advent of jet aircraft, men have wondered about their batting average during a high-speed bailout. Three hundred, four hundred, five hundred miles an hour. Speeds have increased and proportionately so have survival problems. The ejection seat was the first answer and later, capsules and allied double-whammy cases to contain the hapless individual were designed by our scientific thinkers. In the final analysis, however, the jet pilot has often wondered (and sweated a bit) if his body could stand the shock of sudden ejection, the tumbling and at the same time, the rapid deceleration that accompanies a hot-seat ride sans jet airplane.

The Air Research and Development Command scientists engaged in human factors experiments also have been dubious as to whether a human with no protective equipment could survive a high-speed (Mach 1.0 or greater) bailout. Now, recent events have resolved some of these doubts.

The individual who has done most to explore these unknowns is an average-size, quiet, studious-appearing man who closely resembles the popular conception of a college professor, which he was. Lt. Colonel John P. Stapp, the 44-year-old ex-college professor, has a Ph.D. degree in Biophysics, Bacteriology and Physics and an M.D. degree from the University of Minnesota.

However, Lt. Col. Stapp is one scientist who combines action with his scientific theories. As Chief of the Aero Medical Field Laboratory, Holloman AFB, he selected himself as a guinea pig to make the first human run on the world's fastest land vehicle—the new supersonic rocket sled. This sled has many functions. At present it is being used in a series of experiments to determine tolerance to deceleration, windblast and tumbling which are incurred simultaneously during escape from very high speed aircraft at high altitudes.

A speed of 421 mph was reached on the run.

After the initial tests using dummies proved successful, Stapp made his record breaking trip down the 3500-foot rails—attaining a top speed of 421 mph, faster than man had ever traveled on the surface of the earth before. The truly amazing part of his feat is that he knew just about what to expect when he rode the sled as he had taken 26 previous trips down the tracks on a slower sled while stationed at Edwards AFB, California.

Planning for a human test run starts three months before the actual firing. Col. Stapp and his small coterie of working scientists, both military and civilian, write a complete outline of the test, designating the individual responsible for each step of preparation. At X minus three days, a pre-firing conference is held to firm up the details and over-all plan and to be sure that each section and individual understands the designated responsibilities.

Special equipment includes sled mounted cameras, ground cameras for still and motion picture coverage, sled-mounted and ground telemetering units, SLERAN installations (speed measuring units), recorders and special electronic devices used to record the test results on graphs and curve charts.

Actually, the rocket propelled device consists of two sleds—the test vehicle and the propulsion vehicle. Speed is determined by the number of rockets fired at the start of the run. Col. Stapp used six rockets to attain his top speed of 421 mph but eventually expects to ride the sled propelled by 12 rockets, each providing 4500 pounds of thrust.

The 12 rockets will push the sled at 750 mph or approximately Mach 1.0 at the Holloman elevation of 4092 feet above sea level. Since these tests will be conducted in the relatively dense air encountered at this altitude they will simulate a bailout from an open seat at 40,000 feet at 1800 mph.

The propulsion vehicle, when fully loaded with rockets, weighs approximately 3500 pounds and is 84 inches wide and 90 inches long.The test sled which carries the human cargo, weighs about 2000 pounds, is 84 inches wide and 150 inches long and is designed to withstand up to 100G with a 50 per cent safety factor.

The braking system is unique in that it uses water to stop the sled instead of the mechanical brakes on the earlier models. A trough or ditch five feet wide and 18 inches deep extends the full length of the track. At any desired braking point, small masonite dams are inserted to inclose the water for the desired braking distance. Metal scoops extend beneath the propulsion vehicle and the test sled to scoop up water for the braking action. The scoops beneath the propulsion vehicle are deeper than those on the sled, hence it slows faster and permits the sled to separate from it and to travel ahead and stop individually. Forces generated by scooping up the water at high speeds provide a predictable and highly effective braking action and allow the desired G forces to be predetermined.

Following is the account of his record run, written by a man who in the not-too-distant future hopes to be tumbling head over heels at 750 mph while exposed to full windblast, Lt. Col. John P. Stapp, a guy with real guts.

After the initial tests using dummies proved successful, Stapp made his record-breaking run.

Small plastic dams hold the desired water level for braking action of high speed sled.

**By Lt. Col. John P. Stapp**

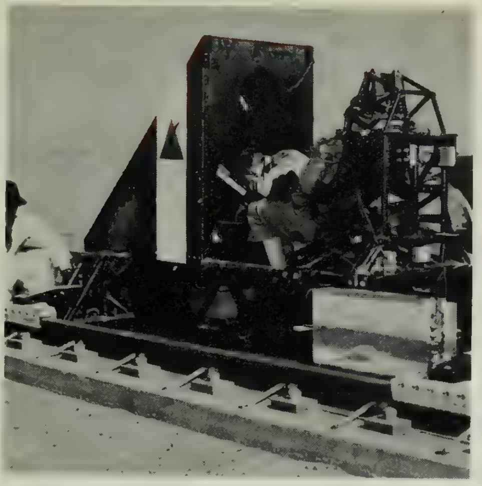
THE aircraft company ads picture needle-nosed ram jet jobs with wings like sweptback ears. They headline them as the "Fastest, Highest Flying Contribution of the Look-Mom-no-wings Aircraft Company to America's Air Supremacy." But, even the superlatives hardly do justice to their products. They are stuck with the simple truth because it would be too much work to think up anything more fantastic, and besides if an aircraft engineer tried to tell a whopper he might be breaking security on a rival company's latest model.

If you don't believe it, look at the progress of aviation in just 50 years —exponential, no less. Where will it end? Very likely with some chief test pilot going into outer space propelled by light beams and grumbling because the universe affords no faster source of power.

The design engineers save their real gripes, however, for one stubbornly unchanging item peeping forlornly from among the titanium rivets —Man, M-1, the same, yesterday, today and forever, fallible, vulnerable, incurably addicted to errors, and above all pathetically mortal.

Some time ago I was project engineer for a series of tests completed at Edwards Air Force Base, California. There it was experimentally demonstrated that the properly suspended human body can survive, uninjured, exposure to crash forces well beyond the material strength that can be built into an aircraft which can still get off the ground. It looked like a good place to rest the case but now it appears to have been only the beginning. I submit a paraphrase of the kind of talk that we are getting from

Technicians prepare the six rocket propulsion unit. Soon, 12 rockets will push sled 750 mph.



"Special equipment and devices are used to record test results on graphs, curve charts."

these insatiable design engineers: "Doc, we are working on a few of the bugs of our model—you probably know all about it, the super Rocket Zilch 1313.

"It goes to Thermal 2—we call it 1313 because any time you go through the Thermal Barrier twice, you've had it two times over. What Mach number? That's for squares still fooling with jets; we're already doing preliminary test on Thermal 3. Confidentially, doc, we've got problems.

"In going up to Thermal 2 or in coming back through it, we have accelerations for durations and magnitudes that you Aero Med people don't have any figures on yet. If we stay at Thermal 2 for very long, we expose the crew to temperatures that look like the thermometer on my wife's electric stove.

"You medics don't have any suits to keep them cool in that range. Doc, how about making up some kind of an asbestos suit and moving the seat on your rocket sled to a position just behind the rockets where you'll be sitting in the flames. I know you can't push a sled up to Thermal 2, but if you can decelerate at 50G for about 10 seconds I think that will simulate most of the factors."

That's no time to smile—you'll find yourself sitting in the back seat of Rocket Zilch 1313 without a canopy, and look who's laughing. Tell him it is impossible? Not on your life, or you'll be forever haunted with the specter of a dewey-eyed eager beaver taking off in the first RZ 1313, waving farewell as he shoots from view—without the asbestos suit.

I guess we'd better put in a long distance call to Johns-Manville and ask them if they have any 8-Ply asbestos cloth, ready for delivery by return air express. "And one more problem, doc. How is he going to bail out? Can we still use the open ejection seat or do we have to go to the ejection capsule?"

About that time I start thinking about the last resort—Titanium Halo M-1, to be adjusted during the last slow roll as the pilot passes through the pearly gates. Oh well, in my business you don't worry about your hat, you just try to hold onto your head.

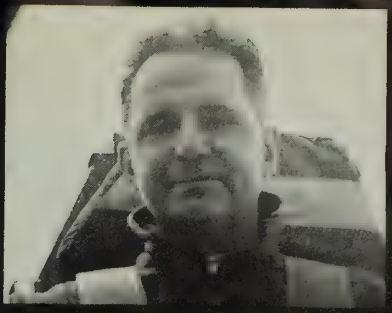
Perhaps the foregoing is a slight exaggeration but the mission of the present program of research in Biodynamics (effects of mechanical force on living tissues) at Holloman Aero Medical Field Laboratory is directed to find the limits of human tolerance to decelerations, windblast and tumbling such as may be encountered in escape from very high performance aircraft.

These experiments are performed on a rocket sled which, in the maximum velocity configuration, operates at the equivalent of pushing a 2000-pound vehicle with 54,000 pounds of thrust.

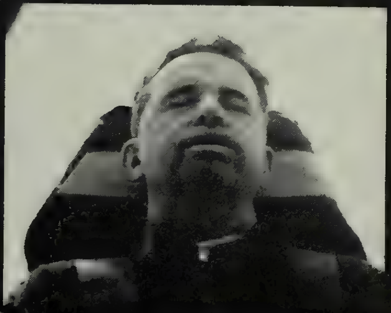
The subject, strapped in a seat, can be exposed to linear decelerative forces equivalent to that experienced after abrupt exit from an aircraft flying at 1800 mph and at 40,000 feet. By abruptly opening large doors in the sled windshield, the loss of a canopy at maximum speed can be simulated and a bungee actuated seat, mounted on gimbals, can tumble the subject head over heels at 180 rpm or less during the application of deceleration and windblast.

The equipment has been delivered to Holloman ADC, and to date nine proof tests have been accomplished,

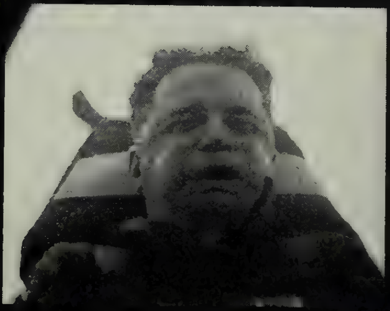
Right, a film strip sequence of Col. Stapp during his record-breaking trip down the tracks.



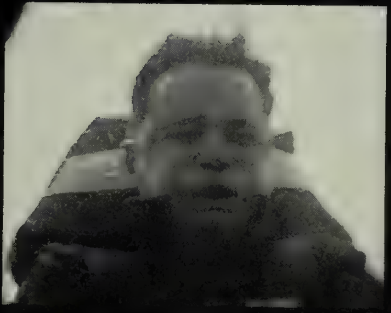
X plus one second



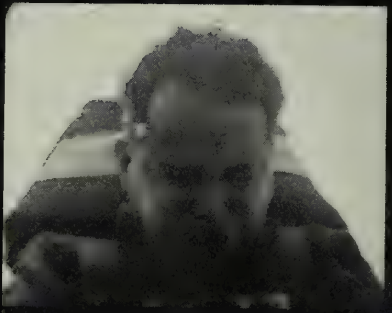
Start of acceleration



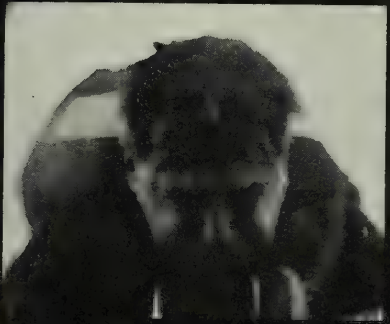
Peak of acceleration



Hitting the brakes



Near max deceleration



22G!

including two tests of the quick-opening windshield doors. We have not personally worked out on the tumbling seat, as yet.

The seventh proof test was a conservative trial to determine suitability of the equipment for human experiments. Project engineers always come first on such occasions, purely to improve the morale of the other subjects. This test was also to serve as a control on windblast tests by exposing the subject to all factors of the acceleration and deceleration that would be experienced except those of windblast.

Anyway, on the morning of the 19th of March at 0615, I had a cup of coffee and an orange and then drove from my house in Alamogordo, where I live alone and lump it. I carefully obeyed all traffic rules en route to my office at the Aero Med Field Lab at Holloman AFB. After signing a few papers and looking over the morning mail, I went to the lab room where Major Dave Simons, USAF (MC) is second in command at our shop. He's a Flight Surgeon whose Space Biology research is concerned with vertical rather than horizontal rockets. We went through all the steps required in the pre-run physical.

The electrocardiograph showed a fast pulse, my blood pressure was up just a little, and I was perspiring some, although the room temperature was not high.

When we were through I put on a sweatshirt and a standard wool blue flying coveralls. I picked up the black gum rubber mouthpiece made to a cast of my dental arches by the base dental lab. Major Jackson, Dental Surgeon, called it a "bite block." I jumped in the car and let Major Simons drive us to Baker 3, where the 3500-foot track is located.

We arrived at 0830 for last minute arrangements. The run was scheduled for firing at 1000 hours. Jake Superata, Northrop lead mechanic, and his crew were checking out the last details of pre-run preparations. Lt. Leonard and Lt. Hack, officers in charge of the Track Unit, were calling back and forth over the intercom from the blockhouse getting all set for that 10 seconds of supreme coordination when cameras, telemetering transmitters, Sleran time-distance recorders and a host of other devices would click in the right sequence to make the precious records of all the intelligence, the analysis of which provides the end product of the run. Six channels on the sled would broadcast to a truck at a relay point, which would re-transmit the signals to Tula Peak, 12 miles away, for recording.

After 26 previous runs at speeds up to 150 mph, Stapp knew what to expect. He hopes to make a test run tumbling in the seat head over heels, exposed to full wind blasts at about Mach 1.

I climbed into the sled, remarking quite honestly that I didn't look forward to this run. The shoulder straps, the lap belt and inverted-V leg strap were positioned and clamped in place. I put the mouthpiece in my mouth. My hands were tied between my knees with webbing. A string to start one of the two cameras mounted at my feet and pointing at my face was handed to me and I was told to pull it at the count of five on the firing sequence.

Almost everybody walked off and left me at the count-down of X-5 minutes, except one instrumentation man doing last calibrations. He was switching over from external to sled-borne power on the transmitters, and two airmen were checking the rocket firing circuits. They soon left. X-3 minutes. I was no longer nervous or worried. Just pull that string at X-5 seconds. X-1 minute—two red flares and a siren signalled from the blockhouse. X-45 seconds. I gripped the bite block, swallowed, moved my head forward and shifted my knees together. X-30. My heart rate was picking up. X-15—here it comes—in a few seconds all hell will break loose but don't forget to pull that string at

Top, track coordinator makes final check. Below, view through bunker periscope of blast-o

**John P. Stapp, Ph.D., M.D.**
**Lt. Col., USAF (MC).**

*Lt. Col. John P. Stapp was born July, 1910, in Brazil of missionary parents. He came to the United States in 1922 for his education, attending Baylor University, the Universities of Texas and Minnesota, among other schools.*

*Col. Stapp was called to active duty in October of 1944 and served in various medical assignments as well as attending several schools of aviation medicine.*

*He was assigned to the Aero Medical Lab of Wright Field in 1946 and was on detached service at Edwards AFB for four years serving as project officer in Human Deceleration. From 1951 to 1953, Col. Stapp was Chief of the Special Projects Section, Biophysics Branch of the Aero Medical Lab at WADC. Since that time he has been at Holloman as Chief of the Aero Med Field Lab, specializing in two subjects—Space Biology and Biodynamics.*

*Col. Stapp has many research achievements, including high altitude unpressurized flight tests of a liquid breathing system; studies on the effect of windblast, including a flight in an F-89 with the canopy removed at 570 mph; and human deceleration studies. The last took in 73 human experiments on a rocket powered sled which was decelerated from speeds of 150 mph by mechanical brakes. He was a volunteer for 26 of these tests, culminating in an exposure to forces of 46.2G during a quarter of a second.*

*During these experiments he sustained numerous injuries, including several broken bones, but succeeded in exploring human tolerance to crash-type forces, establishing human limits considerably in excess of aircraft strength specifications.*

*Col. Stapp received the National Air Council Award for outstanding research contribution by an Air Force officer during 1951, the Legion of Merit for his research in human tolerance to abrupt deceleration and the John Jeffries Award of the Institute of Aeronautical Sciences for outstanding contribution to aeronautics through medical research during 1952. He was elected a Fellow in Aviation Medicine by the Aero Medical Association in 1952.*

★ ★ ★

X-5. Then the count-down. 10, 9, 8, 7, 6, 5—I pulled the string and heard the camera whir—4, 3, 2, 1 FIRE! A brief blasting noise, like an engine blowing off steam, as six rockets, totalling 27,000 pounds thrust, came on simultaneously and the sled seat rammed against my back with an explosive surge.

My head sank into the five-inch thick cushion of rubberized boar's hair. One, two, three, four, five. The sled screamed forward with the most terrific sustained pick-up I've ever experienced. The 26 rides I took in previous years at Edwards AFB on the 2000-foot track had nothing to compare to this. For a fraction of a second, the speed was 421 mph. Then at burn out, the force was suddenly reversed.

For about a second, the rail friction on the sled slippers and the wind drag slowed the sled down with a force equal but opposite to the pick-up of the first five seconds. I was slewed forward in perfect position for the water-brake deceleration which was to follow. Unknown to me, the headrest cushion flew off at this time and gave one horrified spectator the impression that my head had come off. Then the water brakes . . . A smooth, abrupt loading of pressure against the shoulders and hips as I was pushed into the harness, held for noticeably longer than any deceleration I had previously experienced.

The initial surge of deceleration was 22G with a build-up of 500G per second. The subsequent maintained level of force felt perfectly smooth to me, but the records show that in .59 seconds I oscillated 17 times in a sine wave of amplitude diminishing from 10 to about 5G, a pressure change against the harness of about 1700 pounds dwindling to 750 pounds at 30 cycles per second. But I didn't know it and could only take the recording oscillograph's word for it afterwards. During this time the sled slowed down from 313 mph to 156 mph in 200 feet. Less abruptly, the pressure eased off the harness, and after a few seconds, there was a brief impact as the sled hit the emergency water brake and came to a halt.

The water scoops under the sled had knocked out masonite dams and scooped up the water between them, throwing it up 50 feet in the air throughout the deceleration, but I wasn't even wet.

I pulled my right hand out of the webbing and waved an okay. Jake Superata and Major Simons came running up and looked me over anxiously. I took out the mouthpiece and grinned. About that time, my poor confused circulatory system, doing its best to keep the right pressures at the right places through the rapid changes of the last eight seconds, lost its way just a little and I felt a bit woozy, but no different than after many a ride on the centrifuge.

Major Simons says that I was just a little bit pale for about half a minute, but immediately snapped out of it and sat through the picture taking. About that time Colonel Haney, acting CO of the Center, and his staff came up, there was much talking and picture taking. I was happy about the whole thing. I call it survival euphoria and try not to be too ridiculous about it. Finally we got in the car and went back to the lab for the post-run physical. Everything checked out all right. The electrocardiograph was slowed down to normal rate; my blood pressure was back down to 130 over 86, and later to 124 over 80. I wrote up the subjective report, answered some phone calls and started wondering when we would go to lunch. It couldn't come too soon.

The 64-dollar question is, of course, why do it? Why not just use dummies? My answer is that aircraft are still flown by people and if a slightly plump 44-year-old flight surgeon can take it, why can't you? ●

**This is the second of two articles on design problems of swept-wing aircraft, by Engineers of Boeing Airplane Company and Lockheed Aircraft Corporation.**

# YAW LAW

by R. J. White and A. T. Curren, *Boeing Airplane Co.*

THE introduction of high speed swept-wing aircraft into widespread military operation has resulted in many questions from flight personnel concerning the basic design differences between the conventional straight-wing and the swept-wing. This article will explain some of the stability and control characteristics of aircraft with wing sweep in the order of 35 degrees.

We will review several of the main airplane characteristics affected by sweeping the airplane wing and will compare these characteristics with those of an unswept-wing airplane, where such a comparison can be made.

In general, the flight characteristics may be discussed by considering stalling, pitching and lateral and directional control. These will be discussed separately in detail.

### Stalling Characteristics

Basic differences in the stalling characteristics of swept-wing and straight-wing aircraft are clearly illustrated in Figure 1. These plots do not represent any particular aircraft.

Note that with flaps up, the lift curves are similar, and stall warning margins are good in both cases—10 to 20 knots. Maximum lift and minimum speed occur at a greater angle of attack or steeper attitude in the swept-wing airplane. (Attitude or angle of attack may be considered as interchangeable in this discussion.)

In a flaps down configuration, the straight-wing demonstrates a smaller spread between initial stall warning attitude and the full stall attitude.

With flaps down, the swept-wing has a gradual rounding of the lift curve similar to that for flaps up. Figure 1 shows the top of the lift curve to be quite flat. Here the stall warning is definite but a substantial increase in angle of attack or airplane attitude is necessary to complete the stall. As the angle of attack increases, the drag also increases very rapidly, so that a large rate of sink may develop prior to the full stall. In fact, at low engine thrust the stall break may not be apparent to the pilot due to high sink rates. The full stall is usually accompanied, however, by strong buffeting which is termed "vertical bounce" by most pilots.

### Flaps Down Approach

The flaps down approach characteristics are important because the pilot is operating close to the ground and near the initial stall buffet speed during the approach for a landing.

There are both straight-wing and swept-wing jet aircraft which have low drag in the approach configuration due to aerodynamic cleanliness. Some of these aircraft are also equipped with jet engines with poor acceleration capabilities. On these planes the low drag requires a fairly flat approach at low engine thrust to avoid building up excess approach speed which can result in a long floating distance before the aircraft settles down on the runway. Because of the relatively long time (6-10 seconds) required to accelerate from idle rpm to moderate thrust values,

pilots must be alert for the following.

With the aircraft on final approach, flying approximately 10 knots above the initial buffet speed, the pilot may attempt to maintain the desired flight path by raising the nose of the airplane slightly and accepting the loss of a few knots in airspeed. Only a small increase of lift coefficient is required to balance the speed decrease. However, due to the shape of the lift-drag curve ($C_L$ versus $C_D$ curve), a large per cent increase in drag occurs. This is illustrated by point A to B in Figure 2. Unless thrust is immediately increased, a further speed decrease occurs because of the additional drag and the cycle repeats itself until the first stall warning occurs. Figure 2 shows a plot of rate of climb or rate of sink versus airspeed at low engine thrust.

From this it can be seen that if the airplane is flown at an approach speed too near the first stall warning, high rates-of-sink very easily may be encountered. These rates of sink can only be checked by nosing down to re-establish speed or by applying power. A loss of altitude will occur by nosing down to pick up airspeed. This will occur also should the jet engines require too great a time to accelerate up to thrust speed from idle power.

The only way to avoid this situation is to plan ahead. Allow the necessary time to accelerate the engines up to the required power, or have sufficient extra drag in the approach configuration so that a larger per cent of power can be used during the approach. This latter will permit the engines to accelerate faster and will permit the pilot to effectively adjust his glidepath by engines only.

### Pitching Characteristics

Unlike the airplane lift characteristics, there can be no direct comparison between the pitching moments of swept-wing and straight-wing airplanes. The reason for this is that undesirable pitching moments may occur for either type airplane and, in each case these must be modified during the airplane design to give satisfactory pitching moments.

The swept-wing at low speeds first showed that pitch-up (unstable pitching moment slope) can occur at the higher lift coefficients. This pitch-up is due to the stalling of the tip areas which are behind the center of gravity. This causes the inboard lift ahead of the airplane center of gravity to rotate the airplane in a stalling direction. The low speed pitch-up tendency can be cured completely through proper wing, tail and nacelle design. This is essential for a good flying airplane.

As airplane design approached sonic speed, the effect of Mach number produced a high speed pitch-up tendency for many airplanes, both swept and straight-wing. In addition, variations in the pitching moments occurred with increasing Mach number, giving rise to an additional flight effect referred to as tuck-under.

There are, therefore, three pitching moment problems which must be controlled or reduced to a minimum in the design of any high speed airplane. These pitching moment problems are:

- *Low Speed Pitch-Up*

Low speed pitch-up may occur during a low speed stall. Here the nose of the airplane may gently come up as the stall is approached, after which a pitch-down will occur. If this effect is mild, the airplane may still be satisfactory. A severe pitch-up tendency without a following pitch-down cannot be tolerated.

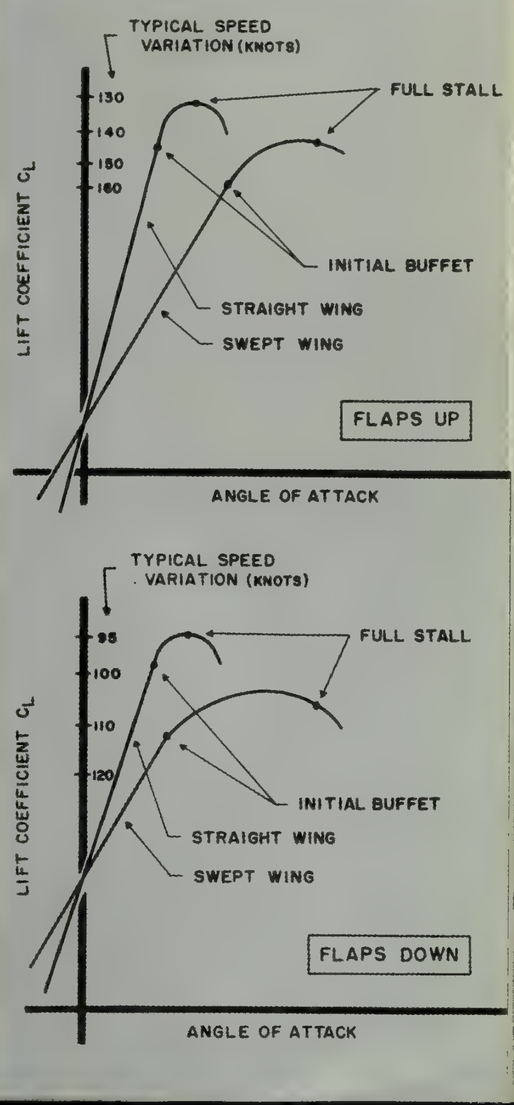
- *High Speed Pitch-Up*

The high speed pitch-up may occur during an accelerated pull-up. Here more G is suddenly realized than can be momentarily controlled by the pilot. This effect is, of course, undesirable, but can be tolerated if the tendency occurs well above the normal operating conditions of the airplane, and if the pitch-up does not result in exceeding the allowable load factors.

- *High Speed Tuck-Under*

The third pitching moment effect is tuck-under. This condition is associated with a change in airspeed and trim during level, unaccelerated (1G) flight. Here, at a certain high trim speed, the airplane may have a tendency to increase airspeed gradually and nose down, requiring the pilot to retrim. If this condition is mild and does not occur in the normal operating conditions, the airplane is satisfactory providing the pilot has sufficient elevator and trim control to bring the airplane back to the desired trim speed.

FIG. I



The lateral control for the swept-wing airplane must be increased over that used on the straight-wing airplane. The reason for this is that the airplane rolling moments developed when the airplane is yawed are greater for a swept-wing than for a straight-wing during low speed flight. Here it is necessary to provide sufficient lateral control to hold the wings level when flying at yaw angles up to the maximum yaw that can be supplied by the rudder.

The rolling tendency produced by yaw is the same as that which would result with a straight-wing having a large dihedral angle. When an airplane with dihedral is yawed, each wing experiences a change in angle of attack which results in a rolling moment. A 35 degree swept-wing with no dihedral has the same rolling tendency at low speeds as a straight-wing having 15 to 20 degrees of dihedral. The effect of excessive dihedral requires the pilot, during steady sideslip maneuvers, to use more lateral control than would be required on a straight-wing airplane. By providing sufficient lateral control with low control forces, desirable flying qualities can be obtained.

It should be noted that the large dihedral effect is in the stable direction. In airplanes with insufficient dihedral, the advancing wing drops when the rudder is applied in a sideslip, thus producing undesirable flying characteristics.

It should be noted that many airplanes are limited in the yaw that can be produced by the rudder at the higher airspeeds. This yaw restriction is purely a structural limitation to save weight in the vertical tail and associated body side bending material. The general way of limiting the high speed yaw angles is to increase rudder pedal forces proportionate to airspeed.

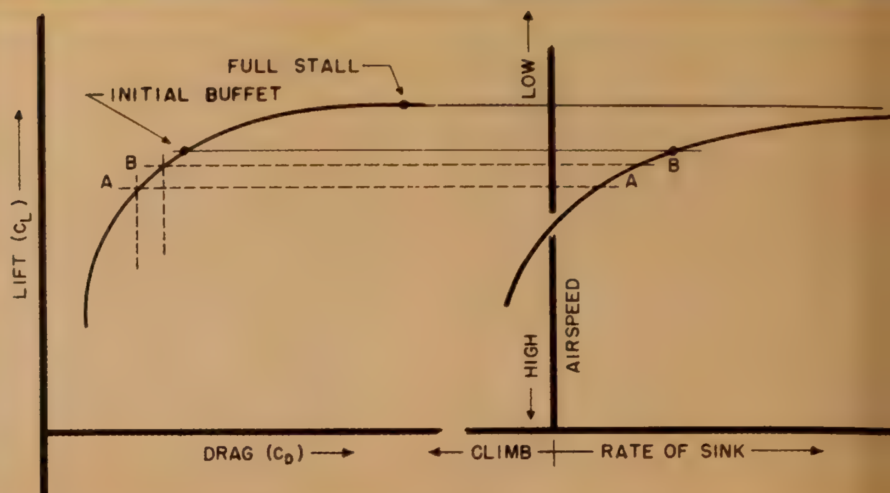


FIG. 2

In regard to the dynamic effects, stability theory indicates that excessive dihedral will produce an airplane lateral instability referred to as "dutch roll." In many present day aircraft, due to high wing loadings and undesirable inertia characteristics, this instability results even for straight-wing airplanes. This has led to the development of the yaw damper which is used to improve the "dutch roll" characteristics.

### Engine-Out Flight

A yawed flight condition can occur when an engine fails on a multi-engine airplane. In a propeller driven airplane, loss of an engine reduces the slipstream over the wing resulting in a loss of lift and an increase in rolling moment, in addition to the expected yawing moment. In the case of a jet airplane, only the yawing moment and the roll induced by yaw will be present. This relieves the amount of lateral control required for a jet airplane for the engine-out condition. Any airplane, whether swept or having a straight wing, must have sufficient rudder and aileron control to handle the engine-out condition.

### Crosswind Landing

During the approach on a crosswind landing, there should be more rudder and aileron control available than that necessary to hold an airplane in its yawed condition. By having an additional amount of control, proper corrections may be made for any upsetting gusts. The additional rudder control can be used to momentarily increase the yaw just prior to touchdown if it is necessary to reduce any existing crab angle. In the case of a swept-wing airplane, the rudder may be used effectively to obtain an additional rolling moment if such is necessary during the landing. Lateral control is, of course, necessary to lift the wing should it drop while near the ground. Both swept and straight-wing airplanes should have sufficient control to meet the crosswind requirements for which they are designed.

### Conclusions

Some of the fundamental differences between swept and straight wing airplanes have been discussed. Here it may be concluded that the low speed handling characteristics are the major differences between swept and straight-wing airplanes. Other problems are common to both types and must be solved through proper design of the airplane.

The difference in the stalling characteristics of these airplanes must be considered carefully by the designer and should be understood fully by the pilots. ●

**by Philip Colman, Chief Preliminary Design Engineer**
***Lockheed Aircraft Corp.***

IN CONSIDERING the flight characteristics of straight-wing and swept-wing fighters, several variables have to be considered. The primary mission of a particular aircraft will have considerable bearing on the final design.

Where speed requirements are high enough, swept planforms have no basic aerodynamic advantage. Every effort should be made to obtain an "all purpose" airplane for both operational and economy viewpoints, but obviously this has limitations. Optimum wing planform helps in approaching realization of this desire.

There are some inherent differences between the swept-wing and straight-wing airplane that must be taken into account by the designer. Certain tendencies manifest themselves in swept-wing aircraft that require mechanical aids to offset undesirable flight reactions. Wing fences, slats, synthetic stability damping and control feel are prime examples of these aids.

All aircraft will fly reasonably well at low angles of attack corresponding to normal flight conditions if properly designed. At high angles of attack, however, such variables as directional stability and roll damping (resistance to roll) tend to decrease and become reversed. Although these characteristics can be present in both planforms under discussion they can be avoided by correct design with straight-wing airplanes and are more severe in swept-wing aircraft.

High outer wing loading, increasing with angle of attack, is a basic characteristic of swept-wing designs. Thus, the outer wing sections stall well ahead of the inner sections, which induces tip stall. Airflow at the tips tends to separate from the upper surface of the wing near the tips and induces a stall in that region while the root or apex portion continues to develop effective lift. The immediate reaction, due to this characteristic of swept-wings, is a pitch-up moment. The degree of this adverse condition is dependent on wing planform, amount of sweep, taper and aspect ratio.

Loss of directional stability and roll damping will occur at the same time. This will occur in normal stalls and equally important, in accelerated maneuvers. Therefore, as noted, mechanical aids must be provided to assist the pilot in overcoming these characteristics and in obtaining a satisfactory airplane from the safety standpoint.

As we have noted, flow separation starts at the wingtips of the sweptback airplane. This leads to another problem. With ailerons located in a conventional position, aileron control effectiveness will become progressively less and disappear as a stalling angle is approached.

It should be noted that reduction in aileron effectiveness is also a high speed problem, because of aeroelastic effects. For equal aerodynamic designs, this is a more severe problem for swept-wing aircraft because of their geometry.

Aerodynamic reaction to the application of landing flaps must also be taken into consideration. Landing flaps are more effective in reducing stall speeds on straight-wings. The straight-wing aircraft gives less stall warning but less is required with good stall characteristics.

Yawed flight is much more critical to aileron control on the swept-wing aircraft because of the inherent high dihedral which promotes considerable roll, particularly at high angle of attack. Normally the pilot will be concerned with yawing only when landing in a strong crosswind. There is the high angle of attack condition and in effect there is a "built-in" yaw or sideslip, developing in intensity in direct proportion to the velocity of the surface wind. During such times, yaw cannot be avoided. If the swept-wing airplane is critical in roll control, additional approach and touch-down speeds must be used to compensate for this condition.

In conclusion we must once again consider the basic mission of the aircraft when discussing the merits of various designs. As we progress further with our studies and flight testing of new designs it must be remembered that our basic planforms may change somewhat. Design requirements between the transonic and the supersonic speed ranges will, in all probability, differ greatly.

In the interim, pilots should be thoroughly aware of the capabilities and limitations of their aircraft whether straight-wing or of swept design. The Pilot's Handbook covers every operational range of the military aircraft. Do not exceed the placarded limitations. Fly the aircraft as it is designed to be flown. ●

**Material for this discussion of seat ejection problems was furnished by Republic Aviation Corp. Field Service Representatives.**

# ...POSITION

TWO fatal accidents occurred last fall that could have been prevented. The lessons learned, as a result of these cases, can and should be understood by all pilots flying jet aircraft.

In the first accident, it was determined that the pilot used improper procedures while strapping in prior to the flight. This later prevented him from clearing the seat following an ejection.

In the second accident, failure of the pilot to use the armrests properly prior to ejection prevented him from using his arms in aiding him to clear the seat and open the parachute.

Although both of these accidents occurred in F-84 aircraft, similar cockpit configuration in other types of jet aircraft could well lead to like cases. FLYING SAFETY urges commanders and flight safety officers to establish immediately a vigorous and intensive training program within their own organizations. Let's see what one overseas squadron did to help itself: The first step of this program consisted of selecting an aircraft and rendering the canopy jettison and seat ejection systems inoperative.

Next, each pilot of that organization, wearing flying clothing and with a full complement of personal equipment, was instructed to secure himself to the seat in the same manner he would use in preparing for an actual flight. Then, at a given signal he assumed ejection position and started the sequence of movements he would use normally to eject and clear the seat. Had the ejection been real, the results might have been tragic.

Several critical factors were immediately apparent. Many incorrect techniques of strapping in were noted and some pilots attempted to actuate the canopy jettison and seat ejection levers improperly.

The most common error made by all pilots was the positioning of the alligator oxygen hose clip which secures the upper end of the oxygen hose (seat half) in a position for easy mating with the oxygen hose from the mask.

The majority of the pilots clipped it to the strap of the left shoulder harness. Technical Order 03-50-1 states the alligator clip will be attached to the clothing; however, most pilots favor the shoulder harness location.

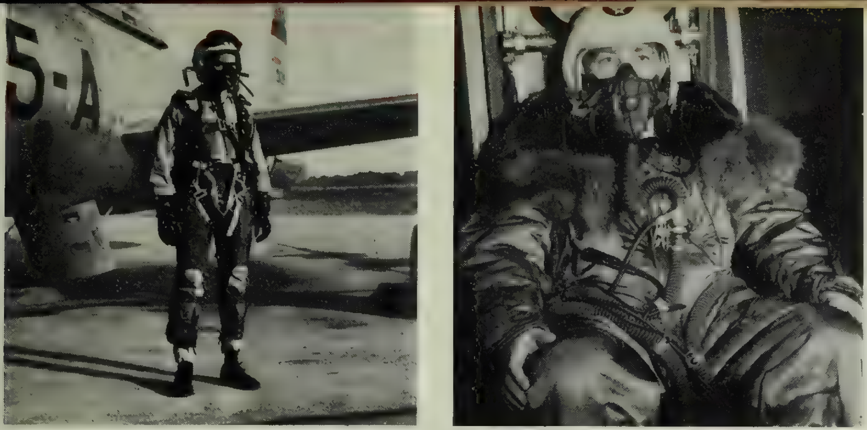
With the clip secured to the harness in this manner, considerable difficulty was experienced in getting out of the seat after the seat belt was disconnected. The reason, of course, is fairly obvious. The clip tended to hold the harness in position over the pilot's shoulder. Time permitting, the alligator should be disconnected prior to ejection.

A second common error was the positioning of the .45 caliber pistol and the routing of the right half of the seat belt. With the pistol worn on the right hip, pistol butt pointing aft, most pilots routed the belt between the gun butt and holster.

With the seat belt and holster tangled up, the pilot has difficulty in clearing the seat. The leather pad and male section of the right hand seat belt lock tend to catch between the holster and the butt of the pistol when the pilot makes a forward motion to clear the seat.

In a few cases pilots wore the .45 pistol slightly forward of the left armpit. With the weapon so placed the clearance between the pilot's left arm and the inboard side of the left canopy seal channel becomes marginal. Under these conditions it is possible for the pilot to strike his left arm on the canopy seal channel as he ejects.

Improper positioning of the body in the seat preparatory to flight was another error found during the program; however, this error was not as frequent as others. For instance, a short pilot, using a minimum of cushions in the seat cavity, must raise the seat considerably to get the desired



"Each pilot, wearing flying clothes and full personal equipment . . . started ejection procedures."

# is Everything !

vertical position. As the seat is raised, the clearance between the top of the back pack and the bottom of the headrest becomes marginal. (This applies particularly to the F-84 aircraft.) Although very little, if any, difficulty was experienced in catching the back pack under the headrest, the armored ripcord housing presented another problem.

With a minimum of clearance between the back pack and headrest, it is possible for the ripcord housing to catch on the lower lip of the headrest or along the aft edge of the guards which are installed on some aircraft. With the ripcord housing catching on the guard located back of the headrest, the pilots were unable to pull forward to clear the seat.

### Preparing to Eject

The most common fault noticed was that the headrest adjustment in the F-84 varied greatly, depending on the height and size of the pilot. With the head thrown back far enough for the P-1A helmet to contact the face of the headrest, it was impossible for the pilot to tuck his chin in properly.

Many pilots neglected to police the cockpit. Some remembered to disconnect the radio jack and then neglected to unhook the oxygen hose. This latter is especially dangerous because upon ejection the rubber hose may stretch a great deal before the quick disconnect lets go. Several pilots have received face injuries as a result of the vicious snap.

A few pilots while practicing the motions of a fast ejection allowed the ebows to protrude on either side (outboard) of the armrests. This practice can result in severe injury to both arms and prevent the pilot from opening the parachute even if the seat is kicked free.

The P-1A helmet, B-5 life preserver, C-9 back type parachute, B-18 seat belt, URC-4 radio set and .45 caliber pistol, used in conjunction with the Mark IV exposure suit, presented additional problems as the pilot prepared to eject.

Some pilots wearing the above equipment had considerable difficulty in positioning their arms properly on the armrests.

As a result of the program established by this one organization, three particularly good recommendations were made. FLYING SAFETY believes they are worth passing on.

- Place the right hand on the canopy jettison and seat ejection levers, keeping the right elbow as close to the body as possible.
- Place the left arm spanwise across the body, keeping the left elbow tucked in, and grasp the right arm firmly with the left hand, holding the right elbow against body.
- In this position, the canopy jettison and seat ejection levers can be actuated and a clean ejection made without fear of injuring the arms.

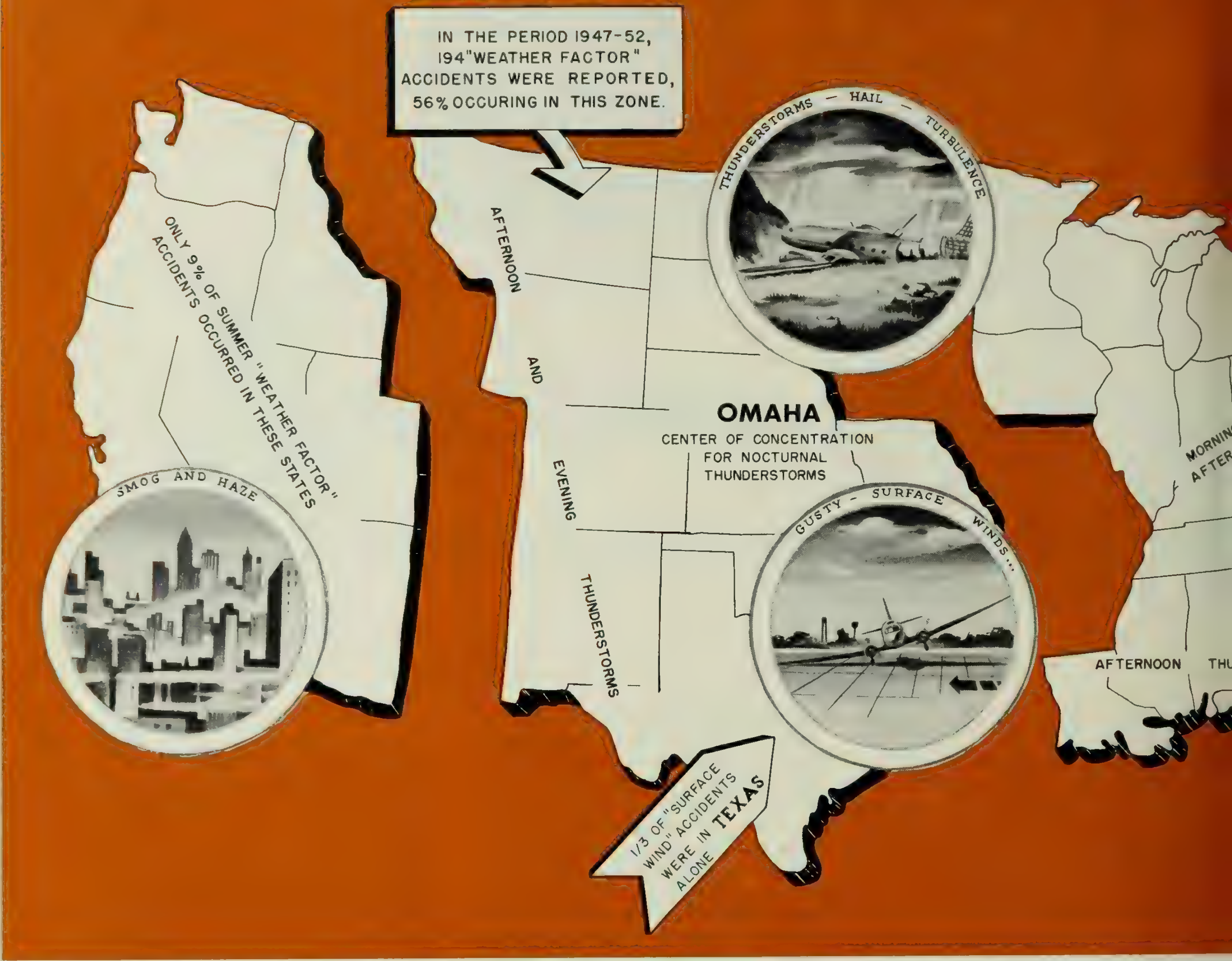
One other factor to be considered concerns the adjustment of the headrest. Such adjustments should be made to suit the individual pilot prior to a flight. The job takes something over a minute on most models and is certainly well worth the effort.

Although not mentioned specifically by the reporting organization, we know that some injuries have been incurred during bailouts because pilots failed to position their feet in the stirrups properly.

Those footrests are placed on the seat for a reason—to get proper position of the legs during ejection. They were designed to get the pilot's feet back from the rudder pedals and the legs bent sufficiently to insure proper clearance of the windshield frame as the seat leaves the aircraft.

If you set up such a program for your pilots, make certain that proper use of the footrests is a *must*. We've seen many a bruised calf and black and blue tootsies on hapless souls who neglected to use the stirrups properly. ●

# SUMMER FLYING



IN THE PERIOD 1947-52, 194 "WEATHER FACTOR" ACCIDENTS WERE REPORTED, 56% OCCURING IN THIS ZONE.

ONLY 9% OF SUMMER "WEATHER FACTOR" ACCIDENTS OCCURRED IN THESE STATES

1/3 OF "SURFACE WIND" ACCIDENTS WERE IN TEXAS ALONE

THUNDERSTORMS — HAIL — TURBULENCE
SMOG AND HAZE
AFTERNOON AND EVENING THUNDERSTORMS
OMAHA
CENTER OF CONCENTRATION FOR NOCTURNAL THUNDERSTORMS
GUSTY - SURFACE WINDS...
MORNIN
AFTER
AFTERNOON
THU

HERE in the ZI, we are now entering the summer flying season. Although we normally think of blue skies and balmy breezes through the summer months, 'tain't necessarily so. Let's look at the record.

Weather elements that are most often cited as contributing causes to summer aircraft accidents are thunderstorms, hail, rain, surface winds and turbulence.

Thunderstorms will be found over the states bordering the Gulf of Mexico and over the Ohio, Missouri and Mississippi River valleys. They are also frequent along the eastern edge of the Rockies with gusty surface winds in Texas. Hail, rain and turbulence are associated with the thunderstorms.

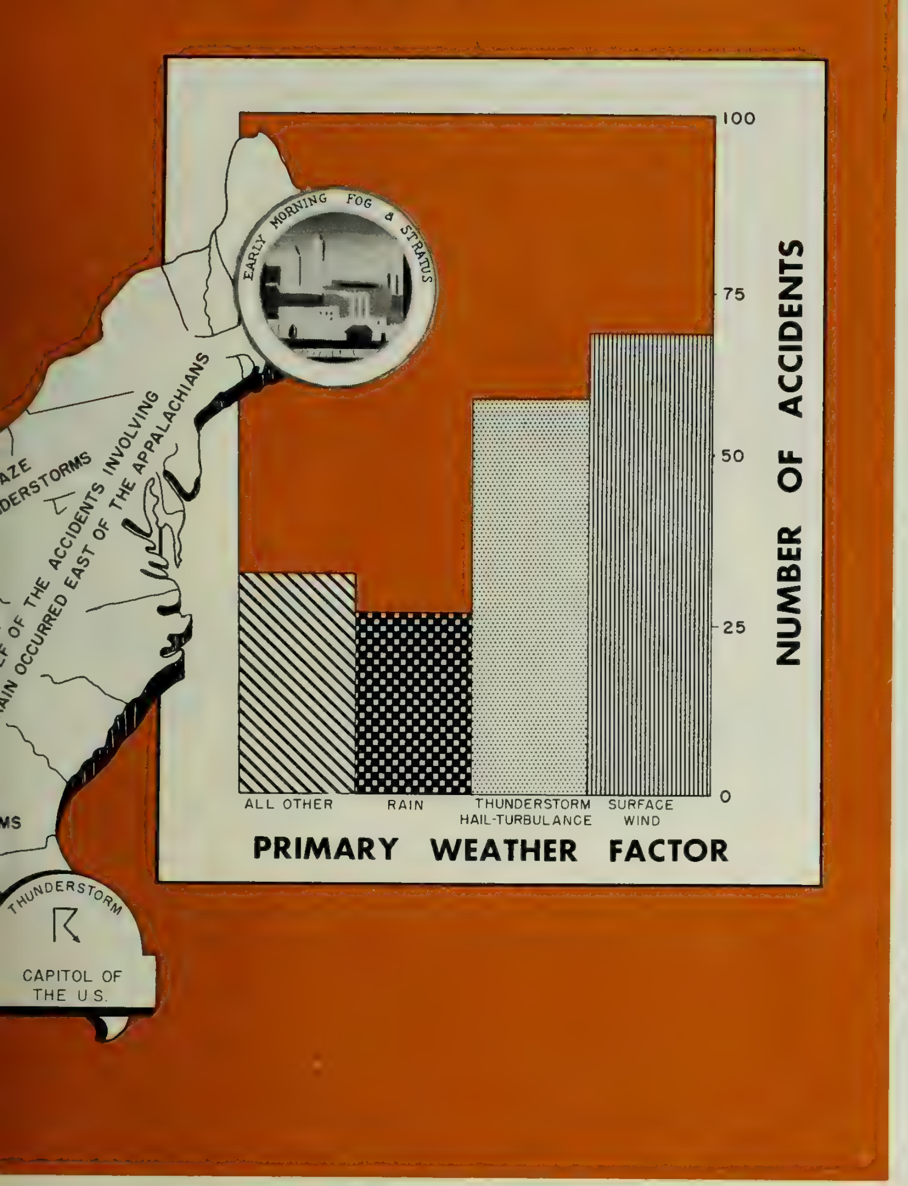
We must also consider low ceilings and visibilities. The New England and Mid-Atlantic coasts, the Seattle area and the coastal region of Southern California around Los Angeles will have lots of that type of weather. The hours from midnight to 0900 will be the time of most frequent occurrence. Certain industrial regions in the Ohio River valley are also susceptible to these foggy conditions.

You may wonder which portion of the United States reports the most "weather" accidents during June, July and August. We've made a study of that too and our records cover a six-year period. According to the record, the Great Plains States from Texas to Canada reported more than 56 per cent of the accidents. The region west of the Continental Divide reported only nine per cent and the balance of the nation reported the remaining 35 per cent.

Most pilots believe that the old thunderstorm is the greatest contributing factor in summer aircraft accidents. That, however, is not true. The seemingly inoffensive surface wind was the villain in 68 of the 194 summertime weather factor accidents. Sixty per cent of those were in the Great Plains States, with Texas alone reporting more than 25 per cent of the "wind" mishaps. Thunderstorms and associated phenomena, such as hail, accounted for about one-third of the accidents.

The majority of accidents caused by thunderstorms and associated

# HAZARDS



weather occurred in the Great Plains States. About 60 per cent of the accidents attributable to thunderstorms have occurred in that area. This figure probably reflects the fact that almost all pilots are familiar with the frequent occurrence of thunderstorms over the southeastern part of the country. However, most airplane drivers are relatively ignorant of the fact that these storms occur with equal frequency over the prairies and along the eastern edge of the Rocky Mountains. Knowledge makes them reluctant to fly into the southeast during thunderstorm season. Lack of knowledge results in no qualms about flying over the Plains States. It is simply a case of not foreseeing the danger and therefore not being prepared to meet it. Or, we might say it boils down to this: more flights into a thunderstorm area, therefore more accidents caused by such summer storms.

Rain is another hazard, accounting for 33 of the 194 weather accidents. Wet runways and rain-blurred windshields were the direct causes most often cited. More than half of these accidents occurred east of the Appalachian Mountains.

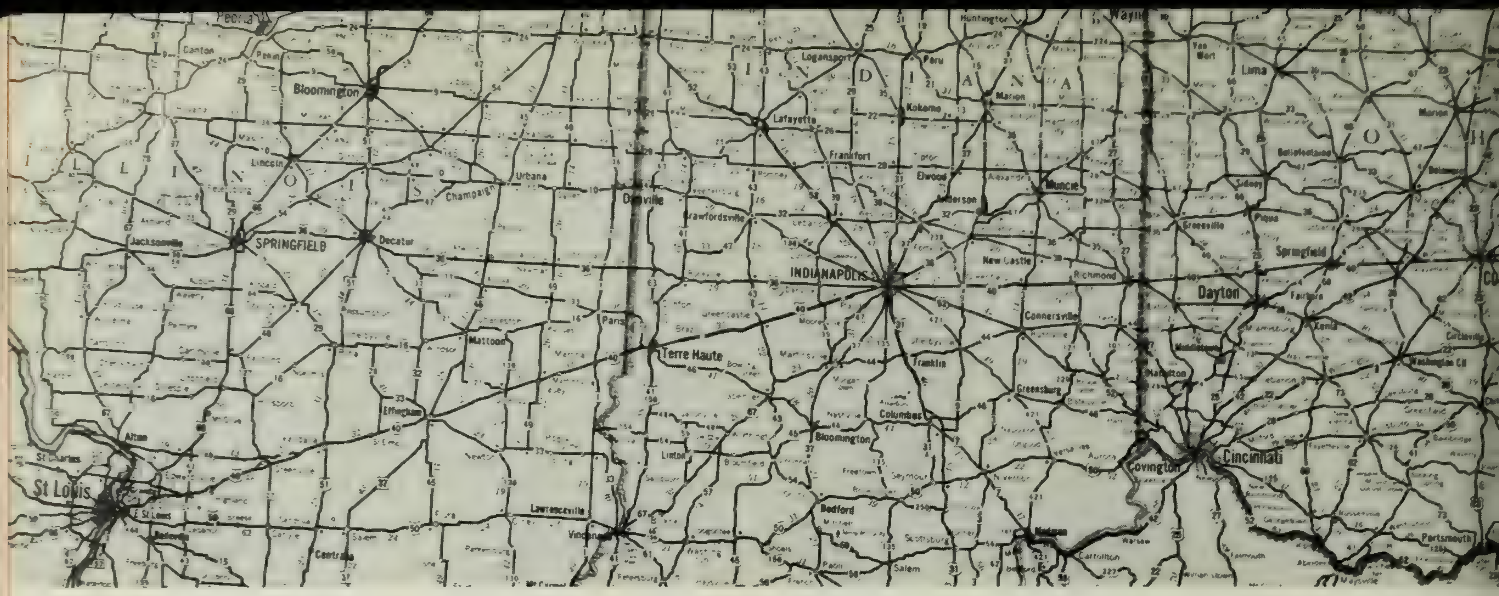
Always a danger in summer, particularly to jet pilots, is the effect of high temperature on air density, which in turn greatly affects the takeoff roll of jet aircraft. A condition of high temperature and low air density can exist anywhere in the nation. Before you take off, check with the weather people to determine temperature conditions. Then a quick reference to the applicable T. O. will tell you how these conditions will affect your particular type of plane. Always be sure to make this check when departing from a field at high elevation. The combination of heat and height can often be dangerous.

The accidents discussed in this article are those in which weather was a contributing factor. In only 27 of the 194 cases was weather the *primary* cause of the accident, and 25 of those cases involved thunderstorms or their offspring.

During the six-year period, five discrepancies were charged to weather forecasters. One involved a failure to forecast thunderstorms along a route, and four were cases in which IFR weather was encountered when VFR weather was forecast.

And now a word of warning to our readers! The facts and figures presented in this discussion are based on past occurrences and averages. We have outlined the areas of maximum occurrence of certain weather elements. However, under certain unusual conditions, any element could be encountered over any portion of the country. To plan your individual flights, check with the forecaster at your local Air Weather Service detachment. He has the latest information available and will do his best to help you plan a safe trip. ●

**"The seemingly inoffensive surface wind was the villain in 68 of the 194 summertime weather factor accidents in a five-year period."**



# Facility Charts--JET SIZE

### by Col. Richard W. Philbrick, Commander, USAF ACIC, with F. H. Redmond

ON a yesterday over twenty-five years ago — 1927 to be exact — a young man named Charles A. Lindbergh took off for a non-stop flight from San Diego to St. Louis. His plane was a silver monoplane, built by Ryan Airlines Company of San Diego. "The Spirit of St. Louis" went on to fly non-stop to New York and then across the Atlantic Ocean.

The only charts or flight information publications Lindbergh carried on his flight across the United States were Rand-McNally state maps and a map of the U. S., which could be purchased for 50 cents at most corner drugstores. They showed railroad lines and main roads. On these maps he marked his route.

Although little weather information was available, it was the most important item in his flight plan. At that time flights might be delayed for days until the weather cleared. The term "IFR" had not been coined. The compass was the primary means of navigation, but generally speaking, instruments were not to be trusted.

Almost 10 years later, another pilot took off from Chanute Field, Illinois, on a flight to Wright Field, Dayton, Ohio. He was using the first Radio Facility Chart publication produced by the U. S. Air Force. These charts were published by the Air Corps Technical School, Chanute Field, and comprised 18 pages of charts and tabulated data. They were 8" x 10½" in size, held together by screw type fasteners.

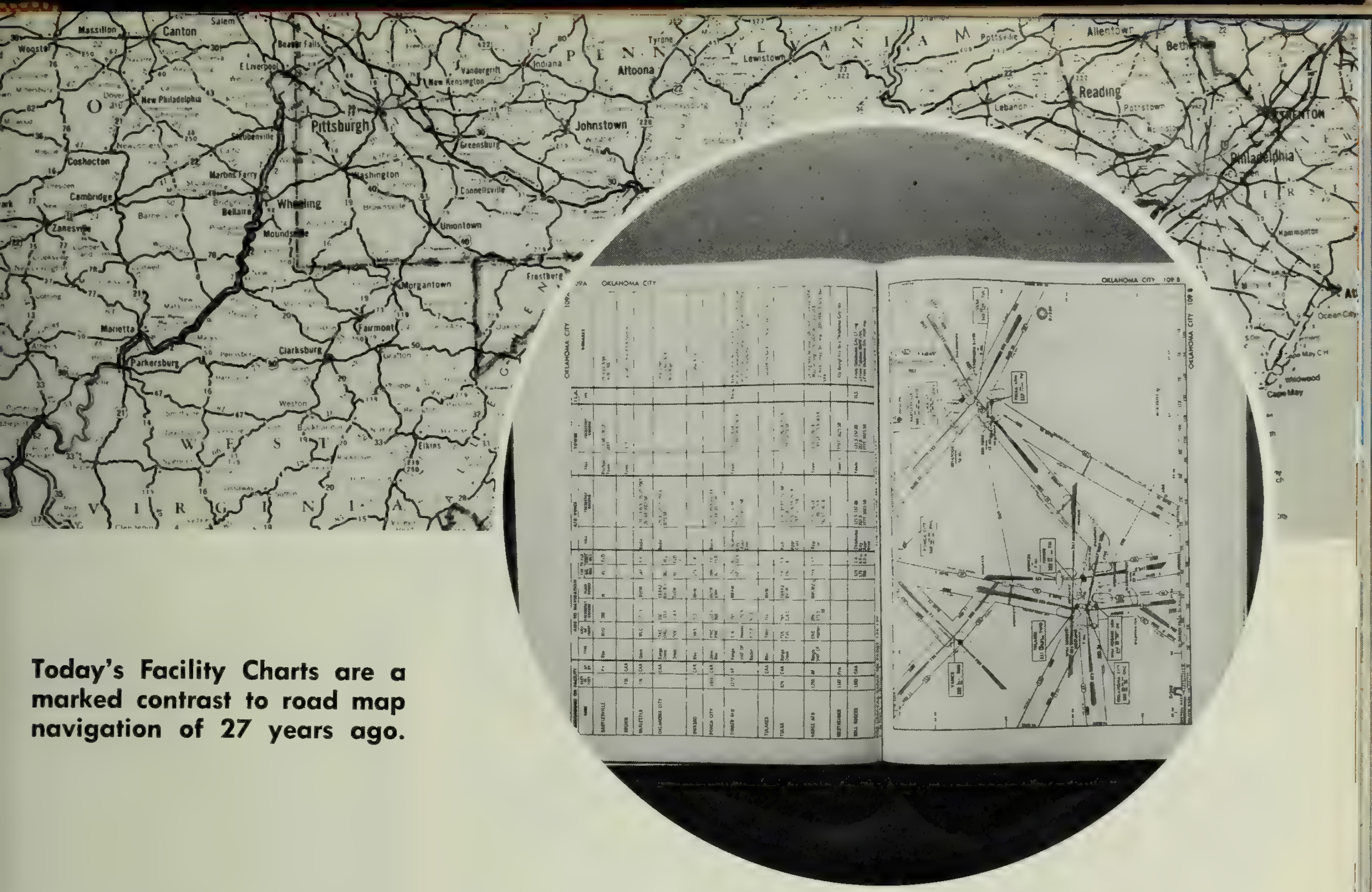
This pilot was flying a B-18, which had a low frequency aircraft radio receiver. Increasing installation of four course radio ranges by the CAA had called for a publication which would give pilots adequate information for navigation by this means. Airways had not yet been designated, but radio range courses had been aligned to permit pilots to follow them directly from one strategic location to another. The new Radio Facility Chart was satisfactory and Air Materiel Command undertook its publication in the Technical Order series.

USAF pilots were using essentially the same type of publication in 1947, but it had grown considerably. Designated airways, danger areas, VHF and HF direction finders, radar beacons, GCA facilities, landing field class and aircraft fuel available had been added. The book now contained 112 pages. No VOR facilities were listed. There was talk of standardizing this publication so that the USAF, the Royal Air Force and the Royal Canadian Air Force pilots would have publications of standardized format for world-wide use. This standardization has since been accomplished and is in the Radio Facility Charts and In-Flight Data issued today. The present publication covering the United States today has 201 pages and a separate publication is issued for VOR airways system.

Today when a jet pilot climbs into his aircraft, taxies to the end of the runway, gets his clearance from the control tower and zooms off, he carries an entirely new type of Radio Facility Chart. He does, that is, if he is cooperating in the USAF Aeronautical Chart and Information Center test and evaluation program, covering the new experimental Radio Facility Charts.

He selects a chart from the material which he carries in the leg pocket of his flying suit. Although it covers a vast area, this chart has been folded to fit compactly into a series of small envelopes. In the narrow confines of the jet aircraft cockpit, he consults this information-packed chart with a minimum of effort.

Reports from users of the standard Radio Facility Charts and In-Flight Data indicate that it is still considered a good publication. The Civil Aeronautics Administration recently re-



**Today's Facility Charts are a marked contrast to road map navigation of 27 years ago.**

quested copies of the U. S. publication for all their airway controllers to use in controlling military air traffic. Years of conference and collaboration with its users have made it the most complete document of its kind.

But when jet aircraft flew into the picture at some 600 miles an hour, the standard Radio Facility Charts could not be used satisfactorily. A jet aircraft could travel across any one of the 8″ x 10½″ charts almost in the time it took to say, "Where on earth does this blankety-blank route go from here?"

In the confines of a jet aircraft, the book must be balanced on one leg, while at the same time one hand is used by the pilot to turn pages. He has difficulty in looking down because of his oxygen mask, Mae West or other personal equipment. If the book slips off his lap onto the floor, he has to grope for it, or he can alter the aircraft attitude in an attempt to retrieve it. If he does, it is entirely possible that he will find himself at some location or altitude where he does not want to be. "Look, Ma, no hands," might be all right on a bicycle, but on a jet instrument approach it just won't do.

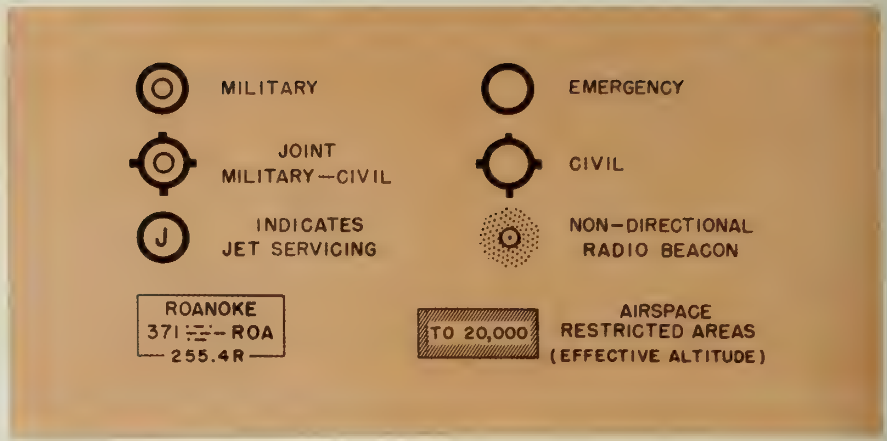
The deficiencies of the existing Radio Facility Charts were pointed out on 10 April 1953 during a visit by Major General Crabb (Chief of Staff, Air Defense Command), to Aeronautical Chart and Information Center Headquarters in St. Louis. As a result of this meeting, an experimental publication was developed to meet the requirements for high speed aircraft.

Air Defense Command representatives came to the Aeronautical Chart and Information Center and sat down at the conference table with the requirements and production personnel of the Chart Center. This conference resulted in the establishment of a fairly stable set of specifications for an experimental series of charts which could meet the requirements for use in high speed aircraft. A lot of questions were asked and answered in the conference. Some of the more important questions and answers included:

- How many charts are required to cover the continental United States allowing a large scale to depict the facilities adequately? *Twelve or thirteen.*
- What symbolization will be used for this chart? *The same as in the conventional publication wherever possible. If necessary, new ones will be developed.*
- How about the two airway systems? Do we issue a separate set of charts for them? *We will publish the VOR airway system on the back of the LF/MF chart, using blue ink for that side.* The first set of experimental Radio Facility Charts was issued early in July; all units of the Air Defense Command received distribution. Copies were furnished at the same time to other major air commands for their test and evaluation.

Thirteen charts cover the entire United States. Both sides of the charts are used, one side for the low frequency radio information and the other for the VOR. Generally, each chart covers a distance of 750 nautical miles east and west, and 250 nautical miles north and south. There is an overlap between charts of at least 50 nautical miles. For ease in handling and carrying, the chart size is 4½″x9″ when folded, and the folds can be turned like the pages of a book. Each fold is indexed to show the major facilities it contains.

For carrying purposes and orderliness, individual envelopes were designed to contain the charts. These have been divided into two sets: Charts 1 to 7 covering western United States, and 8 to 13 covering eastern United States. Envelopes for each



Above, these symbols differ from those used in standard Facility Charts and In-Flight Data.

Below, Col. R. W. Philbrick is considered one of the top USAF authorities on photo recon.

set are punched at the bottom and loose leaf rings are installed to hold them together. The first envelope of each set shows an outline of area coverage for all the charts in the set.

The top fold of each chart gives the number and date of the chart, the general area designation and an abbreviated airdrome directory for that area. Only those active airfields with 5000-foot runways that have servicing and lighting facilities are included. This abbreviated directory indicates availability of instrument landing aids, primary tower frequencies, length of runways and fuel facilities. The back flap of this chart shows a legend of chart symbols, position reporting procedures and emergency radar interceptor procedures.

Specifications and symbols are used the same as in standard Radio Facility Charts and In-Flight Data, with several minor exceptions:

- New radio beacon and airdrome symbols in accordance with recently adopted international symbols.
- Use of a "J" in a circle leadered to a radio facility to indicate that an airdrome has at least minimum jet facilities.
- Use of altitude limits, upper and lower only, of danger areas rather than the conventional numbering system.
- Although the basic chart scale is 1:2,000,000, airways are portrayed at a scale of 1:3,000,000 to permit easier readability in congested areas.

ACIC makes every effort to insure that there are no errors or uncorrected information in this publication — experimental as it is — which might hinder flying safety.

Charts are not reissued on a definite schedule. However, whenever four major changes occur, a new chart is issued. It might seem that this causes undue delay in the inclusion of important changes in the chart. It is a fact, however, that the relocation of an air navigation facility involves more than one major change. Realignment of airways with new reporting points and minimum en route altitudes is also required.

It has been necessary to reissue some of the charts bi-weekly, others once a month, and several others even less frequently. Chart 11, which covers the New York area, has had a higher incidence of changes than any other and, accordingly, has had more frequent revision. Chart 2, which covers the Great Falls-Rapid City area, has been issued less frequently than any of the others: one period of four months required only two new issues of the chart.

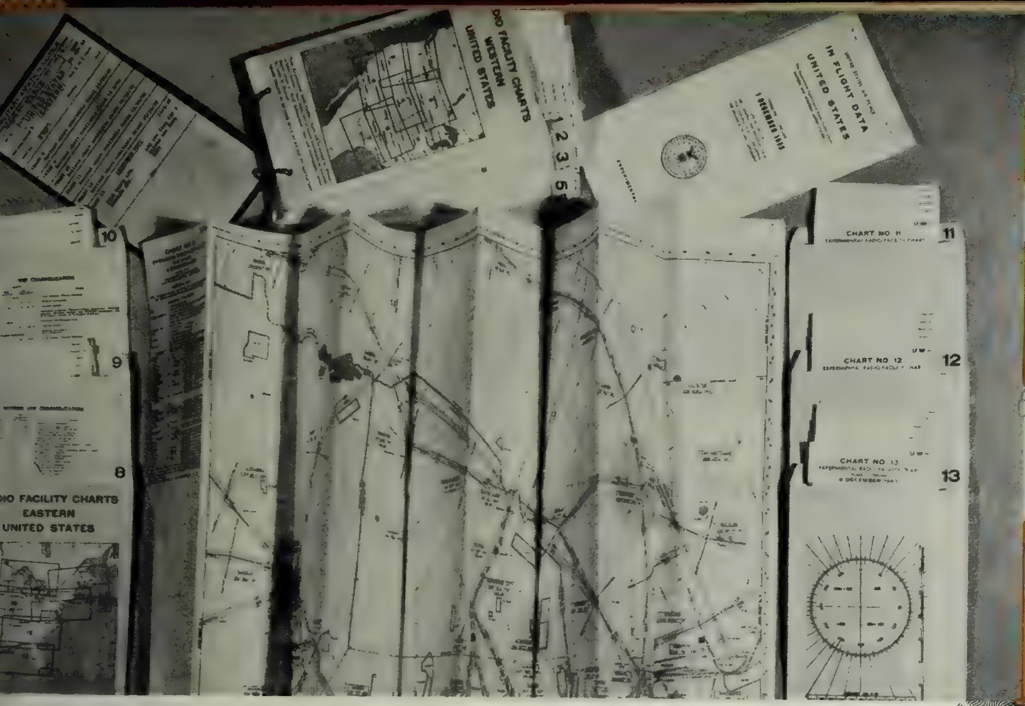
To insure, however, that pilots have access to all vital flying safety information, Military Aviation Notices are issued once every two weeks. These contain cumulative information so that the old one may be thrown away upon receipt of each new one. One Military Aviation Notice covers the eastern United States, the other the western. They are printed with the same bright red border used for most Military Aviation Notices. The 5¼"x9" size permits them to be inserted in the envelopes which hold the experimental Radio Facility Charts. Unless a change is considered critical, it is not included (such as a change in runway length of less than 500 feet). The MANs are considered adequate from a flying safety standpoint to amend the experimental Radio Facility Charts.

As a result of an interim evaluation report from the Air Defense Command, certain amendments to the experimental Radio Facility Charts have been made, such as the addition of UHF air/ground frequencies to identification boxes. First plans to insert U4 and U4R were complicated by USAF changes in channelization which made U5 the USAF channel for the frequency 255.4 megacycles. The compromise use of frequency is in line with the recent USAF decisions that frequency listings rather than channels be used in standard Radio Facility Charts.

Also, ILS approach legs and fan and bone marker beacons were added to the VOR side of the charts. Stick-up containing VHF and UHF channel listings was furnished for affixing to certain envelopes, and a special blow-up chart containing all blow-ups was issued as an experimental feature.

Major air commands have reported that the folded large sheet experimental chart is superior to the conventional publication. The following conclusions were reached from an evaluation of the comments and suggestions received from the commands:

- The experimental Radio Facility Chart is a definite improvement over the standard RFC, particularly with respect to chart presentation overlap and ease of handling.



Thirteen charts cover the U. S. Both sides are used, one for LF radio information, the other for VOR.

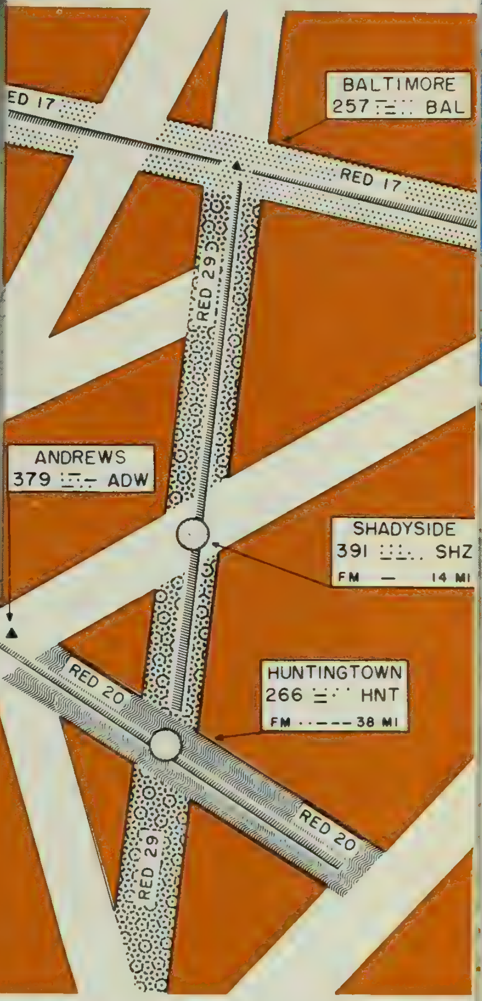


Chart II. Washington area blow-up.

- The size of the experimental chart is considered satisfactory because it allows for convenience in preflight planning and for en route change of flight plan.
- The indexing system and the envelopes are considered to be adequate; however, the envelopes should be made of a more durable material.
- The scale of 1:2,000,000 is considered satisfactory.
- The experimental RFC must include additional data before it can adequately replace the current standard Radio Facility Charts.
- Additional "blow-ups" are needed to portray congested areas in a more adequate manner.

To meet the requirements of ADC and other major air commands for additional supplementary flight information, USAF ACIC issued experimental In-Flight Data U. S. on 1 December 1953 for use in conjunction with the experimental Radio Facility Charts. This, as illustrated in the photo, is a long, slim publication, approximately 5¼"x10", which looks like an insurance policy. In this case, USAF ACIC believes the resemblance is more than physical. This booklet includes Special Notices, Radar (GCA) facilities, ILS facilities, Radar and YG Beacons and details concerning filing of flight plans and ADIZ reporting. It has 35 to 40 pages and can be expanded without difficulty if additional data is required to supplement the charts.

The success of its combination with the experimental Radio Facility Charts will be evaluated carefully. Questionnaires issued by USAF ACIC ask pilots whether any data have been omitted which they believe they might need.

Experimental work in USAF ACIC on improvement of the 13 radio facility charts covering the United States is a continuing project. Some items of experimentation, such as lightening or darkening the airway shading to insure better readability, may not be readily apparent to the user. A new system of showing blow-up areas, as exemplified by the Washington area blow-up on Chart II, should be of considerable interest to pilots who complain of difficulties in finding their way through the seeming maze of airways in some areas.

By using "zip-a-tone," a variety of textures makes it possible for the eye readily to "pick-up" the path of any particular airway. For example: Red airway No. 20 is shown by a strip which looks like a piece of herringbone tweed material. Red 17 is dotted, and the pattern for Red 29 is distinctly reminiscent of one of grandmother's calico prints. All these are designed to help the pilot find his way through areas made congested by the present complex airways system.

A lot of work has been done in other areas of the world to develop publications for use by jet aircraft. A miniature Jet Flight Information publication covering the Japan-Korea area uses the same format as the standard Radio Facility Charts and In-Flight Data publication, but also includes letdown procedures. This type publication has also been issued for use in the Alaskan area.

The Lindbergh flight of 1927 marked a milestone in aviation history. We marvel now at its success considering the limited navigation facilities available. The issuance of the first Radio Facility Chart publication of the U. S. in the middle thirties also was noteworthy. Interesting too, is the fact that the general format and content of the publication has served Air Force requirements up to 1953. What the publication of 1957 will be cannot be predicted today. But perhaps the development of the charts shown in the photo will be another milestone in the development of aeronautical information publications. At any rate, it seems that the future will bring a publication which is compact in size and especially designed for high speed aircraft, but which can be used with equal ease by pilots of conventional aircraft. ●

# Keep Current

NEWS AND VIEWS

**Jet Reverse Thrust**—Jet aircraft in the future may have "reverse thrust" devices for better braking and landing. This development, which has been under study for several years, is designed to divert the power of jet engines so that it is available for braking purposes as soon as the aircraft has touched down on the runway.

Although still in the experimental stage, the thrust reversers will be tried on actual aircraft for further study. Of the many possible types of reverses studied, a "clamshell" reverser seems to be superior in view of design objectives. This clamshell is an extendable device and is stowed around the exterior of the jet engine tailpipe when not in use and is extended into the jet flow after landing. It could be fitted to jet engines buried in the wing, as well as jet pods and the tailpipes of many jet fighters. This device does not have a great effect on engine economy and makes possible a reversal of about 45 per cent of the available thrust.

The thrust reverser some day may make possible jet aircraft landings at all major air fields under all runway conditions.

★ ★ ★

**End of the Line**—Three more of the USAF'S high speed research aircraft are being retired after completing their useful life span of experimental work.

The XF-92A was the first deltawing fighter. It was capable of high subsonic speeds and made its first flight in 1948. Characteristics of the XF-92A included an Allison J-33 engine, midwing configuration and a protruding canopy bubble. Results of its many test flights at the AF Flight Test Center were valuable in the development of the F-102. The XF-92A will hang up its gloves at the Air Force Technical Museum.

Two stablemates, Northrop X-4s, are also being turned out to taste the grass. The X-4 featured two turbojet engines, swept-back wings and was semi-tailless. It was equipped with a tricycle gear and a pilot ejection seat. The X-4 also made its first flight way back in 1948.

One of the X-4s is going to the museum while the other will be used in a static display at the Air University, Maxwell AFB.

★ ★ ★

### Anti-Icing for Jet Bombers

Sensitive nerve ends which constantly take the temperature of surfaces during flight, the compressor of the jet engine and electronic controls are being combined to answer the problem of anti-icing for jet bombers.

Thermal icing, of course, is nothing new. It was developed during World War II and put into service shortly thereafter. Still earlier methods were based on the principle of de-icing. In piston-engine aircraft the anti-icing method involves the installation of combustion heaters in the tail and nacelles, with hot air piped to the surfaces.

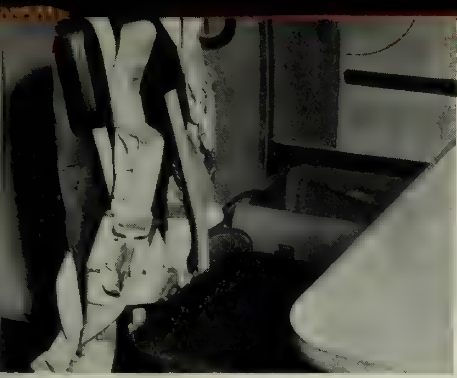
The jet aircraft presented the possibility of a better system with its ready made source of high-pressure, high temperature air. That source is the compressor. However, this air often runs over 700 degrees and its effect on the surface of the aircraft must be controlled. So, enter the electrical receptors. These have a resemblance to their counterparts in the human body, man's sensory nerve ends which report thermal extremes to the brain.

Each of the aircraft's sensing elements is a coil, sending signals through electronic nerves to an electronic control. This coil is made up of 13 feet of fine wire, wound up in an aluminum case about the size of a silver dollar. The nerve end is set flush into the skin on wing and tail surfaces.

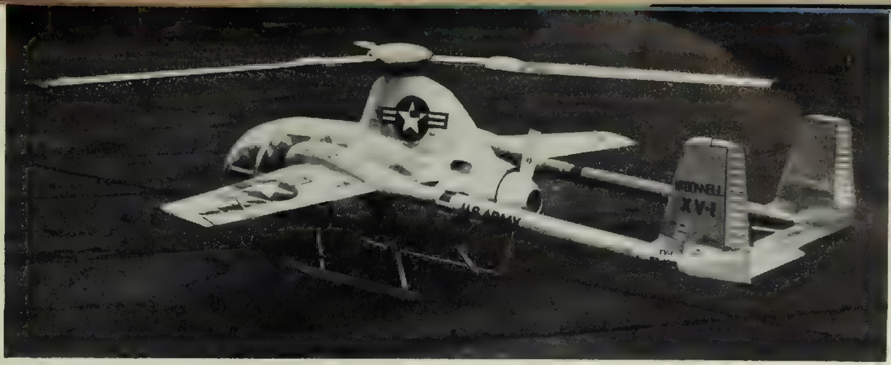
As fluctuations in temperature occur, the wire's resistance to a small electric current also changes due to the peculiar properties of the metal alloy from which the wire is made. The changing resistance of the wire results in a signal which is picked up and interpreted by the electronic control regulator of the system. This device regulates the flow of heated air by operating a modulating valve. The regulator is set to maintain the surfaces at a constant 100 degrees while the system is in operation.

The anti-icing system itself is comprised of air ducts buried in the leading edges. These ducts must take the full pressure from the engines and are of stainless steel. Hot air is delivered direct to the inner surfaces of the skin, top and bottom, through a series of fine holes in the ducts. Sprayed through these, the air filters back through a series of small passages along the entire surface.

The pilot's part of this operation is very simple. He merely throws on a switch on the instrument panel when he wants anti-icing protection.



Left and above is Capt. T. E. Roberts' idea for using a chest type parachute as a shoulder harness in the event of a crash landing. Many crew seats are conducive to this system.



The Convertiplane embodies a new concept of flight, the unloaded rotor. This revolutionary aircraft is equipped with a rotor for vertical flight, and wings and a prop for horizontal flight.

**Convertiplane Completed** — A joint development of ARDC, the Transportation Corps of the Army and McDonnell Aircraft Corporation, has resulted in the XV-1 Convertiplane. This aircraft embodies a new concept of flight—the unloaded rotor. In other words, a machine equipped with a rotor for vertical flight, and wings and a conventional propeller for horizontal flight.

The primary mission of the XV-1 will be the exploration of the application of this principle to larger aircraft. Studies also will be made on the tactical use of the aircraft for reconnaissance, observation and other related missions.

In vertical flight or while hovering, the rotor provides all the lift. In forward flight, of course, the wings provide the lift. This allows the rotor to auto-rotate at its lowest drag configuration, avoiding the speed limitation encountered by conventional helicopters due to stalling of the blades when carrying lift at high speeds.

Each of the three blades of the rotor is powered by a McDonnell-developed pressure jet unit located at the tip of the blade. A continental reciprocating engine is provided on the aft fuselage to supply air to the jet units during vertical flight and power to the prop for forward flight.

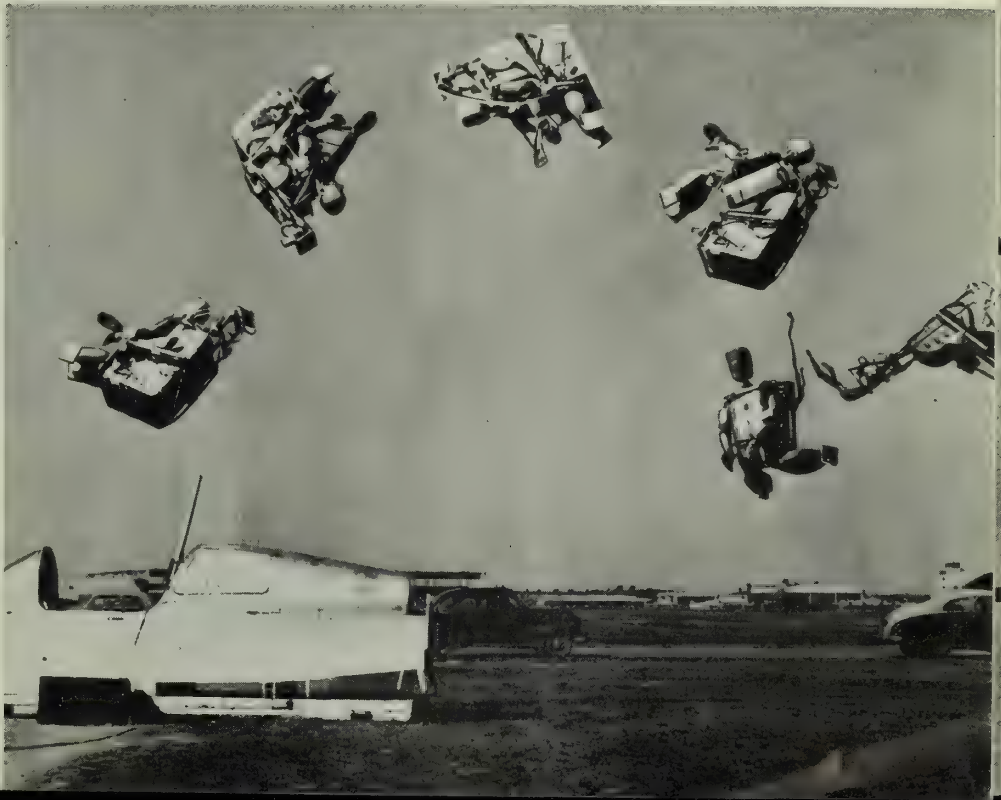
The power available from the jets allows the use of a rotor having approximately half the drag of a conventional helicopter rotor. As the wings do not need to provide lift during takeoff or landing, they are about half the size of the wings for conventional fixed wing aircraft. Therefore, speed performance of the XV-1 is not penalized greatly by utilizing both rotor and wing.

The research program on the XV-1 will include much ground testing, instrumentation and preliminary flight test work, including full scale wind tunnel testing.

## ODDS and ENDS

- The 179,000 rivets in a modern jet fighter would tower two and a half times as high as the Empire State Building if placed on top of each other.
- One of the Air Force's latest fighter-bombers, the F-84F, "breathes" as much air in a minute as an adult does in four months.
- At the speed of sound, the leading edges of a low flying aircraft grow 95 degrees warmer than the surrounding air; at 10 times the speed of sound they can reach 9000 degrees Fahrenheit.
- Another achievement in flight safety was recorded when Bell Aircraft's Helicopter Division at Ft. Worth flew 7569 test flights without damage to aircraft or injury to personnel in 1953. Total flight time was 2074 hours.
- The National Bureau of Standards has developed an altimeter which will measure altitudes as low as two feet. This non-quantized, frequency-modulated altimeter makes it possible for a helicopter pilot to know when his 'bird' is within several feet of the landing surface.

A new pilot-ejection seat developed by Republic is tested in composite picture below. The seat has a device which automatically disconnects the safety belt at the peak of the arc after ejection.



# MIXMASTER MYSTERIES

By Major Russell G. Winegar
Gary AFB, Texas

BEFORE the recent action in Korea was a year old, a lone YH-19 was sent to the Far East for field service testing under combat conditions. This YH-19, capable of carrying a considerably greater load than any other helicopter then in operation in Korea, arrived on the scene about the time our Intelligence people were anxious to get their hands on a MIG-15, or any part thereof. So when a photo reconnaissance mission reported that one had crash-landed up east of Sinanju, a pilot, copilot and cloak-and-dagger team climbed aboard the new aircraft and headed for the crash site.

After the MIG pieces were picked up, it was necessary for the helicopter to churn through an area of busting flak to get back to home territory. Flak, obviously radar controlled, completely surrounded the YH-19. As every pilot knows, the most effective way to evade flak is to keep changing altitude, airspeed and heading. Changes of heading caused no problem, but rapid changes of altitude and airspeed resulted in the pilot's inadvertently exceeding safe airspeed. During evasive maneuvers, violent beats developed in the aircraft.

Fortunately, the pilot recognized his problem as blade tip stall induced by excessive airspeed, and was able to take immediate corrective action. The new helicopter got back to friendly territory without difficulty, its important cargo intact.

Because every helicopter pilot must be prepared to deal with stalls such as this, it may be a good idea to review the reasons for stalling and the corrective action that is necessary, once a stall is induced.

Now stalling, as applied to fixed wing aircraft, does not occur in a helicopter. There are, however, two types of stalls to which all helicopters are subject:

(1) Blade tip stalls, which may occur in high speed flight.

(2) Rotor stalls (commonly spoken of as "settling with power") which may occur during a vertical or low transitional speed descent.

Blade tip stall refers to a stalled condition occurring at the tip portion of a blade in the retreating half of the rotor disc during high forward speed. (See Figure I.) It is a result of the low speed of the retreating blade and of the high positive angle of attack that is necessary on the left side of the helicopter to produce the extreme tilt of the rotor needed for high speed flight. Or, to put the same statement in a slightly different manner, blade tip stall is similar to the stall experienced in frozen wing aircraft because of the slow speed of the retreating tip and the *high blade loading* of the outer section of the rotor blade. It is a localized condition and exists throughout only a small portion of the rotor disc.

Contributing factors to blade tip stall, in addition to a high forward speed, may be high gross weight, altitude, acceleration and power, turbulence, low rotor rpm and G forces. The effect of air turbulence or violent maneuvers in relation to safe airspeed (wherein blade tip stall ordinarily will not be encountered) cannot be overemphasized. Instances have occurred in which conditions of blade stall were produced at airspeeds of 60 knots or less, even at low altitudes, because of severe turbulence, gusty wind conditions or violent flight maneuvers.

Turbulence or any maneuver which increases the load factor reduces the

**Recently much discussion has centered around helicopter flight characteristics. Here are the views of one experienced instructor on this subject.**

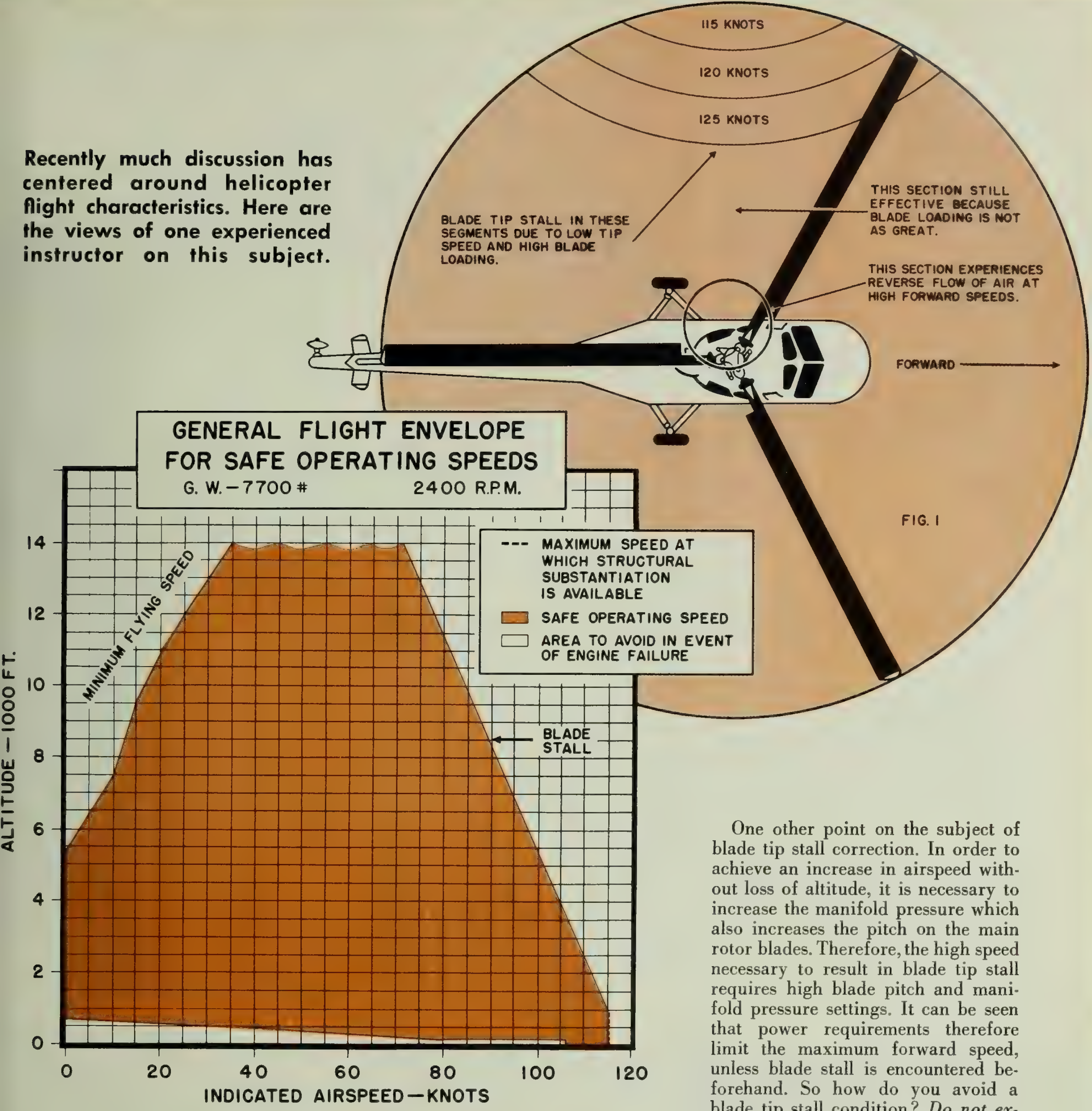

115 KNOTS
120 KNOTS
125 KNOTS
BLADE TIP STALL IN THESE SEGMENTS DUE TO LOW TIP SPEED AND HIGH BLADE LOADING.
THIS SECTION STILL EFFECTIVE BECAUSE BLADE LOADING IS NOT AS GREAT.
THIS SECTION EXPERIENCES REVERSE FLOW OF AIR AT HIGH FORWARD SPEEDS.
FORWARD
GENERAL FLIGHT ENVELOPE FOR SAFE OPERATING SPEEDS
G. W.—7700 #
2400 R.P.M.
--- MAXIMUM SPEED AT WHICH STRUCTURAL SUBSTANTIATION IS AVAILABLE
▨ SAFE OPERATING SPEED
☐ AREA TO AVOID IN EVENT OF ENGINE FAILURE
MINIMUM FLYING SPEED
BLADE STALL
ALTITUDE — 1000 FT.
0
2
4
6
8
10
12
14
0
20
40
60
80
100
120
INDICATED AIRSPEED—KNOTS

FIG. I

maximum forward speed at which blade stall will occur. *An additional load factor of one-tenth of a G reduces maximum speed for blade stall by 10 knots.*

The pilot will recognize blade tip stall by a peculiar roughness in the airframe and controls. The roughness will be in the nature of a three-per-revolution beat, occasioned by each blade reaching the stalling region, then recovering. This roughness will be felt even though the flight control servos are operating.

When blade stall occurs, it may be eliminated easily by accomplishing any one or a combination of the following:

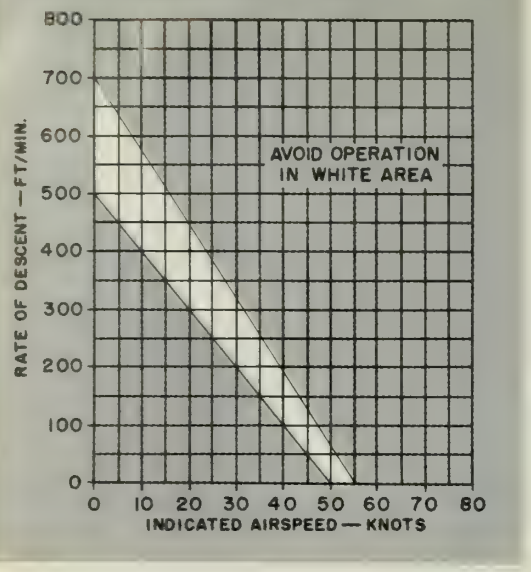
- Decrease airspeed.
- Increase motor rpm.
- Reduce main rotor pitch.
- Decrease severity of the maneuvers.

Most rapid recovery will be effected if the pilot combines all four corrections. Figure I shows the locale of the tip stall and the approximate speeds at which it occurs.

One other point on the subject of blade tip stall correction. In order to achieve an increase in airspeed without loss of altitude, it is necessary to increase the manifold pressure which also increases the pitch on the main rotor blades. Therefore, the high speed necessary to result in blade tip stall requires high blade pitch and manifold pressure settings. It can be seen that power requirements therefore limit the maximum forward speed, unless blade stall is encountered beforehand. So how do you avoid a blade tip stall condition? *Do not exceed the airspeed allowable after proper consideration has been given to these factors: Altitude, rpm, load condition, turbulence and violence of maneuvers.*

As noted in Figure I, it is evident that the middle portion of the rotor blade is not subject to the tip stall just discussed. Although the airspeed of the middle portion of the blade is slower than that of the outer tip, it is still effective because the blade loading in that area is considerably less than that existing at the outer portion. On the extreme inner por-

POWER SETTLING



tion of the blade, however, the airspeed becomes less and less until there is a complete reversal of airflow at high forward speeds.

"Settling with power" (a rotor stall) is a phrase commonly used by helicopter pilots to describe a particular state of flight that brings about a fast vertical rate of descent. This phenomenon is encountered during vertical or nearly vertical descent, when the rate of descent is at least 300 fpm and horizontal velocity is no higher than 10 knots. It is brought about by a reversal of airflow through the rotor, which forces the blades to operate at angles of attack above their maximum coefficient of lift. Studies have shown that blade stall starts near the hub and progresses outward along the blade as the rate of descent increases. The application of collective pitch and power, with no increase in airspeed, results only in stalling more of the blade area, thereby producing an even more rapid descent rate.

Settling with power is normally experienced by a helicopter pilot because he has miscalculated. He may find himself in this predicament as a result of:

- An attempt to hover out of ground effect at an altitude above the hovering ceiling.
- An attempt at hovering out of ground effect without exercising precise altitude control.
- A low-speed, steep, straight or spiraling, partial-power descent where the airspeed is inadvertently "zeroed."

Settling can be hazardous if encountered near the ground (below 1000 feet). Rates of descent exceeding 2200 fpm have been recorded during settling. The characteristics of settling are very similar to the feel of stall in a conventional aircraft. That is, roughness in the airframe and controls and some loss of control effectiveness. Directional control, particularly, becomes very difficult because of extreme force of torque.

The recovery procedure is also approximately the same as that used in a fixed wing aircraft. Drop the nose and accelerate into forward flight. Recovery also can be made by reducing collective pitch to the minimum, which will result in vertical autorotation almost immediately. This procedure, however, results in very rapid loss of altitude.

As mentioned before, the blade tip stall condition and the rotor stall condition are accompanied by roughness and vibration in the controls. During a blade tip stall the pilot is aware of a "beat" or resonance. It may be of help to discuss the various disturbances or mechanical malfunctions which will cause roughness or resonance in helicopter operation.

Here are some definitions of helicopter troubles as outlined in this article:

- *Control Unbalance* — Any rotating body, whether it is a wheel, a gyroscope or a rotor, moves in a given space pattern. If this space pattern is disturbed by an external force (which can be the air, an internal disturbance of the controls by the pilot or a disturbance set up in an auxiliary boost control unit), unbalanced forces will be transmitted by the rotor to its mounting structure in the helicopter. This unbalanced force may be of such an amplitude and frequency that a resonant response is obtained throughout the entire aircraft.
- *Tracking Unbalance* — A rotor which is greatly out of track may set up an unbalanced condition (tracking unbalance) which will be transmitted throughout the helicopter. This type of unbalance usually results in nothing more than a rough helicopter and a "beat" in the cyclic control stick. If enough track unbalance exists, it is possible that a combination of factors may result in resonance.
- *Damper Vibrations* — If one or more dampers do not provide sufficient damping, then resonance will occur if the frequency of the blades swinging about their drag hinges lags or leads the blade out of its 120° pattern, causing the helicopter to shake or vibrate. In turn, this vibration or shaking motion of the helicopter will aggravate the out-of-pattern condition of the blades, and both the blade out-of-pattern and the shaking or vibrating of the helicopter will build up until the helicopter is destroyed.
- *Hinge Bearing and Hinge Pin Vibrations* — Flapping hinge bearing or horizontal hinge pin bearing vibrations build up slowly over a period of time. Complete failure of this bearing will cause severe vibrations throughout the helicopter, resulting in possible resonance.

With all this information in mind, the helicopter pilot will probably come to the conclusion that blade stalls need not be particularly dangerous. That conclusion is certainly correct, despite widespread rumor to the contrary. As in any other aircraft, the pilot needs only to know what factors induce stalls, how to recognize the condition when he encounters it, and what action on his part will correct the situation. ●

| ALTITUDE FT. | GROSS WEIGHT LBS. | RPM | |
|---|---|---|---|
| | | 2100 | 2400 |
| S.L. | 8500 | 74 | 110 |
| | 7500 | 85 | 115 |
| | 6500 | 96 | 115 |
| 5000 | 8500 | 57 | 93 |
| | 7500 | 68 | 104 |
| | 6500 | 79 | 115 |
| 10,000 | 8500 | | 76 |
| | 7500 | 51 | 87 |
| | 6500 | 57 | 98 |

MAXIMUM SPEED AT WHICH STRUCTURAL SUBSTANTIATION IS AVAILABLE

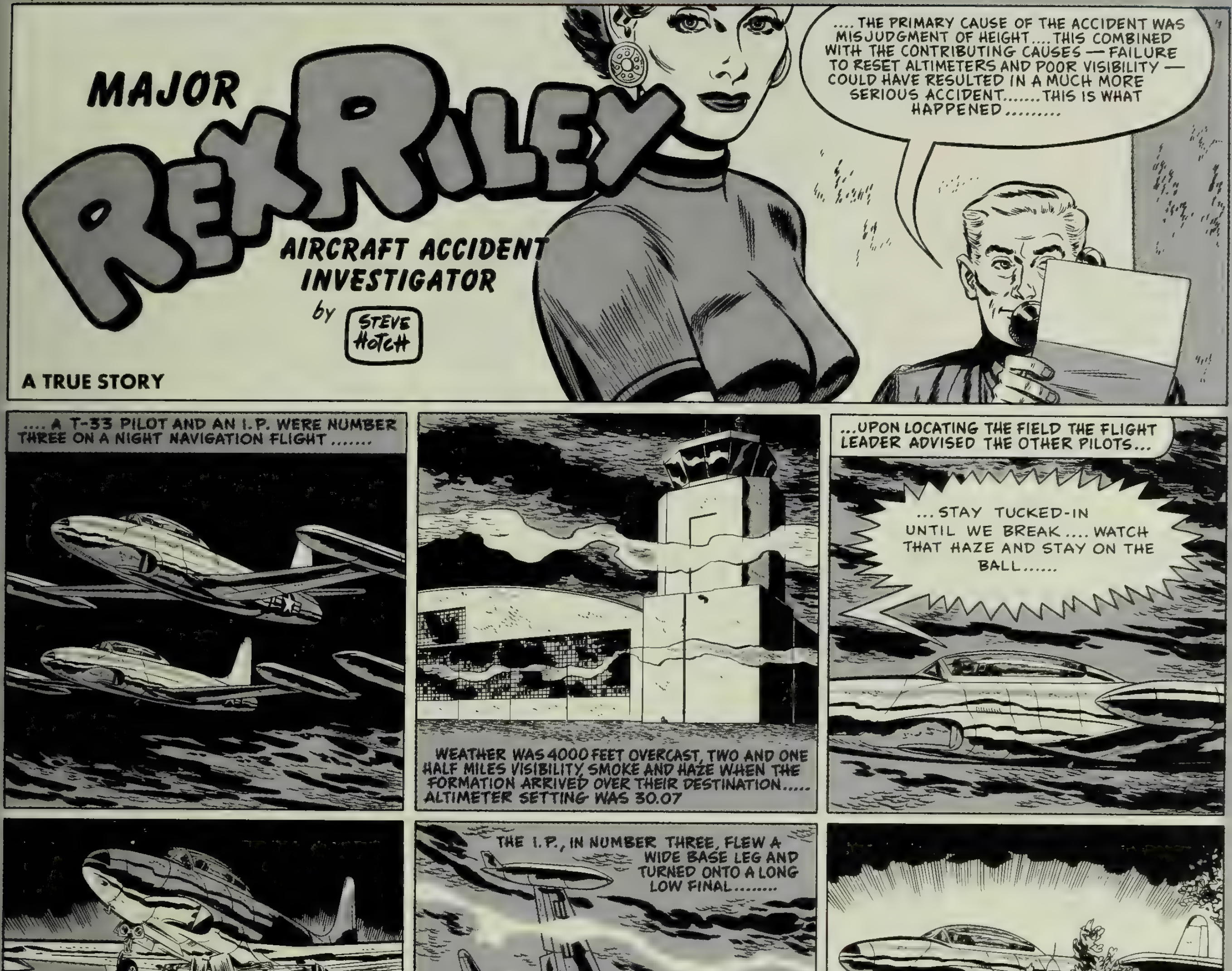
**MAXIMUM SPEED**

(NOT TO BE EXCEEDED BECAUSE OF BLADE STALL OR STRUCTURAL LIMITATION)

**NOTE:**

1. FOR ACCELERATED FLIGHT, REDUCE SPEEDS.
2. FOR MILD GUST CONDITIONS, REDUCE SPEEDS 10 KNOTS.

   FOR HIGH GUST CONDITIONS, REDUCE SPEEDS 20 KNOTS.
3. SPEEDS NOTED ARE INDICATED AIRSPEED IN KNOTS.


MAJOR
REX RILEY
AIRCRAFT ACCIDENT INVESTIGATOR
by STEVE HOTCH
A TRUE STORY
....THE PRIMARY CAUSE OF THE ACCIDENT WAS MISJUDGMENT OF HEIGHT....THIS COMBINED WITH THE CONTRIBUTING CAUSES — FAILURE TO RESET ALTIMETERS AND POOR VISIBILITY — COULD HAVE RESULTED IN A MUCH MORE SERIOUS ACCIDENT.......THIS IS WHAT HAPPENED.........
....A T-33 PILOT AND AN I.P. WERE NUMBER THREE ON A NIGHT NAVIGATION FLIGHT.......
WEATHER WAS 4000 FEET OVERCAST, TWO AND ONE HALF MILES VISIBILITY, SMOKE AND HAZE WHEN THE FORMATION ARRIVED OVER THEIR DESTINATION..... ALTIMETER SETTING WAS 30.07
...UPON LOCATING THE FIELD THE FLIGHT LEADER ADVISED THE OTHER PILOTS...
...STAY TUCKED-IN UNTIL WE BREAK.... WATCH THAT HAZE AND STAY ON THE BALL......
THE HAZE ACCENTED THE FULL BRIGHTNESS OF THE RUNWAY LIGHTS....REQUESTING THAT THEY BE DIMMED THE LEADER AND NUMBER TWO LANDED SAFELY........
THE I.P., IN NUMBER THREE, FLEW A WIDE BASE LEG AND TURNED ONTO A LONG LOW FINAL........
....3200 FEET FROM THE RUNWAY THE T-33 STRUCK A LARGE TREE!
...UPON IMPACT, POWER WAS ADDED AND A GO-AROUND MADE...THE TOWER REPORTED NO VISIBLE DAMAGE AND THE LANDING WAS COMPLETED....
...THE LEFT WING, LEFT FLAP AND INTAKE SUFFERED MINOR DAMAGE...NEITHER THE I.P. NOR THE STUDENT HAD RESET HIS ALTIMETER...TAKEOFF SETTING WAS 30.47 AND DESTINATION SETTING 30.07...THIS WOULD CAUSE THE AIRCRAFT TO BE 400 FEET LOWER THAN THE INDICATED ALTITUDE...INACCURATE SETTINGS PLUS HAZE MADE THIS INSTRUMENT PRACTICALLY USELESS AS AN AID IN DETERMINING HEIGHT ABOVE THE GROUND !!

The pilot, as well as the aircraft, must be in shape for every flight. Being in shape means caring for yourself just as an athlete trains for the Olympic Games or other athletic events.

# YOU IN THE BLUE

*FLYING SAFETY is indebted to the Douglas Aircraft Company, Inc., for the following article. Through their co-operation we are presenting highlights of their Flight Fitness pamphlet, prepared by the Engineering Div.*

YOU, as a pilot, should be familiar with certain factors affecting the human body. Knowledge of these factors will assist you to carry out your flight missions safely and in an efficient manner.

Probably you've been exposed to quite a bit of this information previously. Most of it is contained in various medical publications but is not readily available or expressed in simple terms.

Just as there are restrictions on your airplane, there are restrictions on what you can do. You might say they were determined by design limitations practiced by the Almighty when He built you. These are built-in and must be remembered just as well as those in your airplane. When all is said and done, there is only one way the two of you can function effectively, and that is as a team.

The real purpose of this article is to bring sharply to your attention the fact that you can put additional restrictions on your team. They are under your deliberate control and you can't blame the Almighty or science for failures occasioned by your own deeds or misdeeds.

### Human Restrictions

Restrictions on the human body can best be expressed in terms of the lack of power to overcome physical stresses. These vary depending upon environment. Flying presents a number of stresses which are found only in this particular field. One group is classified as natural stresses because they are built-in and are not induced by our own efforts. Let's examine some of these stresses and see how they affect your ability as a pilot.

*EXPOSURE TO ALTITUDE WITHOUT OXYGEN* — We're not going to delve too deeply into this subject. It's a continuing subject with us and we'll be hitting it again soon in FLYING SAFETY.

However, just remember that oxygen is as necessary for the functioning of the human body as it is for the combustion of fuel. Your body uses oxygen in much the same fashion by combining it with a carbon compound to produce energy and gives off carbon dioxide as a waste.

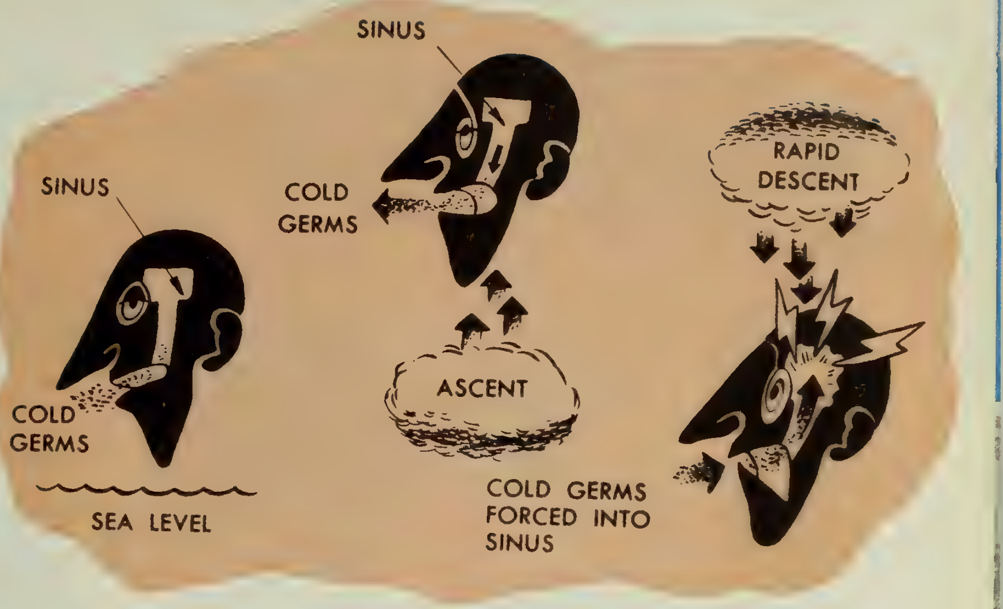
Be sure to review your technical directives on the use of oxygen at frequent intervals and carry them out religiously.

*EXPOSURE TO CARBON MONOXIDE* — Carbon monoxide, when absorbed by the blood, can be extremely dangerous, as we all know. It reduces the amount of hemoglobin available for carrying oxygen to the tissues and makes the transfer of whatever oxygen is present difficult. It is absorbed by the blood more than 200 times more readily than oxygen and is more difficult to dislodge from the blood.

The danger of carbon monoxide, especially in combination with lowered partial pressure of oxygen at altitude, cannot be overemphasized.

FLYING SAFETY covered the dangers of carbon monoxide poisoning in the May issue. If you didn't read it, better get a copy and dig in right now.

*EXPOSURE TO RAPID ALTITUDE CHANGES* — Rapid pressure changes, incidental to changes in altitude, present no problem if you are in good physical condition, since normal clearing of the ears will permit balancing the pressure between the middle ear and the outside air.



The problem arising from exposure to rapid altitude changes when flying with a severe cold may well come under the category of "asking for it."

*EXPOSURE TO NOISE AND VIBRATION* — Noises in aircraft are derived principally from the propeller, exhaust, moving parts of the engine and aerodynamic sources. Noise intensity is measured in decibels. Research indicates that a noise level of 116 decibels, when sustained for over a period of six hours for eight successive days, may be of sufficient intensity to cause irreparable hearing loss.

Helmets, earphones and earplugs all have their place and certainly do help but there's no denying that excessive noise, over protracted periods, causes a lot of fatigue. Keep that in mind and remember that a couple of mills churning in your ear can slow up your reaction time, but plenty.

*EXPOSURE TO MOTION* — Some people tend to become airsick easily. Others are never bothered. There's no one single cause for all cases. The symptoms are very clear and unmistakable. If you are susceptible, you will learn for yourself what your best course of action should be, what food items to avoid and how much of what motion you can take. Consult your flight surgeon and work out together the best plan for you.

*EXPOSURE TO VISUAL DISTURBANCES* — There are a number of disturbances and distortions that can occur during flight. Haze, color distortion, motion paralax and vertigo are familiar to all pilots. Also, certain optical illusions such as those caused by lights reflected from water or scattered lights in unsymmetrical patterns on the ground, can cause confusion and disorientation. The only logical answer is "use those instruments!"

### The Self-Induced Stresses

Exposure to the following self-induced stresses is within your control. Read 'em and remember 'em. It's your neck that's out, and, quite possibly, several others may be on the block with it!

*INADEQUATE REST* — We don't need to dwell on this one. You *know* how much sleep you need. If you deliberately skip this one factor, brother, you're looking for trouble. In case you don't know, lack of sleep reduces your efficiency and this in turn reduces your tolerance to stresses and slows reaction time.

*COLDS* — We're not going to dwell on colds in this article. You've been warned many, many times about leaping off into the blue when a head-cold is raising hob with your system. We've classed colds under self-induced stresses because they mean much more in flying than in your ordinary terrestrial existence. The cartoon depicts just how cold germs louse you up when flying.

*SELF-MEDICATION* — See May 1954 FLYING SAFETY. If you want to put the doctors out of business, best you get a license to practice.

*ALCOHOL* — It shouldn't be necessary to dwell on this subject that's so near to the heart of so many. Alcohol slows down mental performance and reaction time and it takes many hours for its effects to wear off. In modern aircraft the slow jockey may well be the dead one. Either join the AA's or play it real cool. Remember, *you* are the worst judge of the effects of alcohol upon your system and perhaps little realize what it does to your fitness.

*POORLY CONTROLLED EMOTIONS* — An untroubled mind is one of the greatest assets you can have. This is especially true when you consider the mental tasks and reactions required of you while flying. With split-second tasks to perform you may find yourself really behind the eight-ball if you have been flying along worrying about your finances, love life, mother-in-law or other equally disturbing conditions.

If your problems seem too great for you to solve, if you should worry constantly, you'd better take them to your banker, lawyer, doctor or chaplain. It's a cinch you shouldn't fly under mental strain. It leads to distraction from your normal functions, doping-off and if continued, to a case of psychoneurosis. Then, if you haven't fouled-up enough in the meantime to need an undertaker, you'll probably require the services of a good psychiatrist.

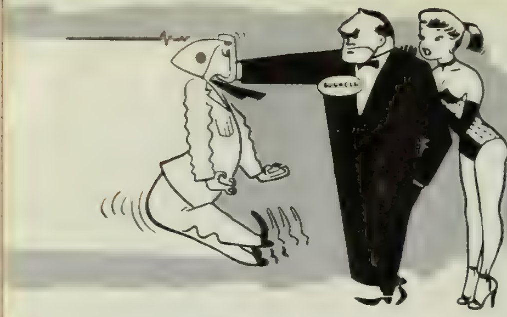
*EXPOSURE TO ACCELERATIONS* — There are four kinds of accelerations that pilots may expect to encounter:

★ Moderate G lasting for some time. This is the kind encountered in pulling out of a dive (aircraft, that is). This causes the blood to be thrown into the lower part of the body and if it lasts long enough, the heart does not get enough blood to keep up the circulation. Black-out may result.

★ High G of short duration—less than a second. This is unavoidably built into the ejection seat in order to get a trajectory that will clear the empennage.

Position yourself correctly prior to an ejection and there's no sweat on this one.

★ Sudden forward deceleration. This is encountered in crashes. The threat from this kind of deceleration



RAPID DECELERATIONS CAN BE DANGEROUS

is the chance of developing a gunsight complexion. Proper use of the shoulder harness will preclude this kind of a mess.

★ Tangential G of short radius. This is encountered in tumbling and buffeting. We can't give too much of an answer on this one, yet! Apparently not too severe unless the blowtorch gets pretty far gone.

*UPSET STOMACH* — This condition may vary from a mild tummyache to one accompanied by excruciating pain. Flying should not be attempted when suffering from this condition since your efficiency and tolerance to inherent stresses will be considerably lowered.

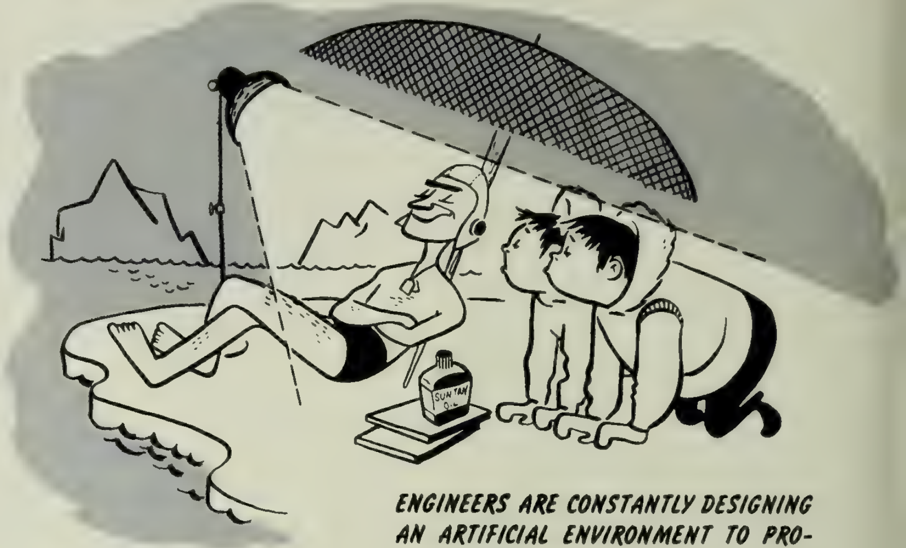
Distension of gas in the stomach and intestines can be the cause of these symptoms. Avoid gas-forming foods especially if you are going upstairs. If you want to know what gas-forming foods are, see your long-suffering flight surgeon.

*SMOKING* — There is one very sound reason why smoking can reduce the fitness of the pilot. The carbon monoxide resulting from incomplete combustion of the tobacco is the same as that which comes from the engine. The combined effects of the carbon monoxide and reduced oxygen at altitude can be harmful.

Remember, too, that excessive smoking can affect your night vision a great deal. The old depth perception can really get knocked off center if you go charging through the black of night, leaving a trail of tobacco ashes behind.

One last thought on tobacco. Maybe this doesn't apply to you, but it could! Many pilots have been known to yank off the oxygen mask long enough for a quick smoke. Figure it out. Mix one faulty regulator (leaking type) with one match (lit) and step clear! It has happened.

SMOKING, LIKE OTHER - ER - THINGS - IS BEST IN MODERATION! JUST DON'T OVERDO IT!



ENGINEERS ARE CONSTANTLY DESIGNING AN ARTIFICIAL ENVIRONMENT TO PROTECT YOU

*HEAT AND COLD* — We could write reams on this subject but for the sake of the record we'll only say: Dress for the occasion. Uncle has invested a lot of dough in developing and procuring adequate flight clothing to meet the demands of practically every clime. When you are issued gear for protection, learn the reasons for it and get familiar with its use. You can't keep fit if you let yourself get exposed to even uncomfortable degrees of heat or cold.

*EMPTY STOMACH* — Food to the human body is like fuel for an engine. Fortunately, the mechanics of energy conversion in the human body do not require a continuous supply of food. Your body also has the ability to store up reserve energy permitting you to function between "refuelings." To function efficiently, however, you must maintain regular meal schedules — preferably on a three-meal-a-day basis.

The reason for this is simple. If you allow too much time between meals, your potential energy level drops below that required for your efficient operation before you refuel your engine again.

Eat right and feel right!

To boil all of this down just remember that important stresses affecting pilots have been covered briefly. This information has been offered to impress upon you that:

- Stresses exist which are detrimental to flight safety.
- Other stresses may develop as a result of your failure to maintain physical fitness.
- These stresses are not only detrimental individually, but their effects are also ADDITIVE and as such may result in the failure of your mission and may even cost your life.

To quote that well-known Ground Safety cliche, "The life you save may be your own." Play it cool, brother, and stay loose. ●

**Natural Stresses**

Exposure to altitude without oxygen.
Exposure to carbon monoxide.
Exposure to rapid altitude changes.
Exposure to noise and vibrations.
Exposure to motion.
Exposure to visual disturbances.

**Self-Induced Stresses**

Inadequate rest.
Colds.
Self-medication.
Alcohol.
Heat and cold.
Empty stomach.
Upset stomach.
Smoking.
Poorly controlled emotions.
Exposure to accelerations.

# POSITION
## is everything

As the title implies, proper position means the difference between a successful ejection or possible failure. If you haven't already done so, be sure to read the article, starting on page 12.

★ ★ ★

FLYING SAFETY realizes the value of a bit of cheesecake. YOU looked at the gal, didn't you? Now, don't skip the story.

Barbara Ruick — MGM.

# Mal Function

Mal looked with scorn on rocket sled
"Just junior hot rod," so he said.

"These science guys, it's plain to see
"May kid the troops, but not fool me."

Mal insults the whole test crew
As this poor dope is wont to do.

He needles on while Jato men
Hook rockets up and then—oh then—

Placed on sled, flat on back
No-hands Louie, down the track.

★ U. S. GOVERNMENT PRINTING OFFICE . . . 271143

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FLYS

JULY 1954

# FLYING SAFETY

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tornado bailout
page two

# FLYING SAFETY

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NUMBER SEVEN

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. . . FASTEN WHAT LEG STRAPS ?

## SUBSCRIPTIONS

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★ ★ ★

The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payment can be made for manuscripts submitted for publication in FLYING SAFETY magazine. Contributions are welcome as are comments and criticisms. Address all correspondence to the Editor, FLYING SAFETY magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Non-Air Force organizations must query the Editor before reprinting, indicating how the material will be used. The contents of this magazine are informational and should not be construed as regulations, Technical Orders or directives unless so stated.

USAF PERIODICAL 62-1

# CROSS FEED

LETTERS TO THE EDITOR

### Safety Records

Local Flying Safety plaques were presented recently to Sections I and II of the Pilot Training Group at Williams AFB, Arizona. As the Wing Flying Safety Officer I am very proud of the records established by these two sections while training aviation cadets in T-33 and T-28 type aircraft.

Section II compiled 11,297 accident-free hours between the periods of 14 May 53 and 12 January 54.

Section I compiled an equally fine record of approximately 10,685 accident-free hours between the periods 3 July 53 and 10 January 54.

The term accident-free hours includes both major and minor aircraft accidents.

**Capt. William E. Davis, Jr.**
**Wing FSO, Williams AFB, Ariz.**

★

We thought FLYING SAFETY might be interested in the safety record chalked up by our outfit. During the two years the 6520th Flight Test Squadron has been operating at Hanscom Field, it has flown more than 11,000 hours accident-free. And this, despite the fact that the squadron is using six types of aircraft including the B-29, B-17, C-97, C-54, C-82 and C-47; is operating from a 5000-foot runway and is flying in all kinds of weather for which this area is famous. (As the natives say: "If you don't like the weather, wait a minute!")

None of us here claim that our Flight Test Squadron has set a flying safety record, but we're all mighty proud of our accomplishment of flying two years without an accident of any kind.

**Capt. George M. Khoury**
**FSO, 6520th Flt Test Sq**
**Hanscom Fld, Bedford, Mass.**

★

On the 20th of March 1954 the Fourth Tow Target Squadron at George AFB, Calif., passed a milestone in safety. After 9,642:50 hours of flying since 20 March 1953 there was not a single accident during the one-year period.

There have been 15,171:20 hours flown since the last major accident on 10 June 1952. This accident was caused by a gunner's top escape hatch coming loose in flight, after two hours in the air. The accident was classified as a major by virtue of cost and manhours involving repairs. There were no injuries.

During the past year the squadron has flown a total of 8,253:00 hours day, 943:00 hours night, and 446:50 hours weather. This record can be directly attributed to the quality of maintenance, and efficiency of the pilots and aircrews.

Four different type aircraft are flown by the Fourth Tow Target Squadron: B-26, B-29, B-45 and C-47. Its missions include towing, tracking, ferrying, training and administrative operations.

*FLYING SAFETY is proud of these records, also!*

★ ★ ★

### Tape for Escape

Being an extremely safety-conscious outfit, the 31st Air Transport Squadron (H) of the 1600th AT Gp (MATS), has found great interest in the article, "Detection through Reflection" (FLYING SAFETY, Oct. 1953), by the 4th Troop Carrier Squadron at Larson AFB, on the use of reflection tape as inexpensive insurance against aircraft accidents.

We are in complete agreement with the 4th TC Squadron's use of the tape and have found an additional use of this magic material; that of marking emergency escape panels on aircraft.

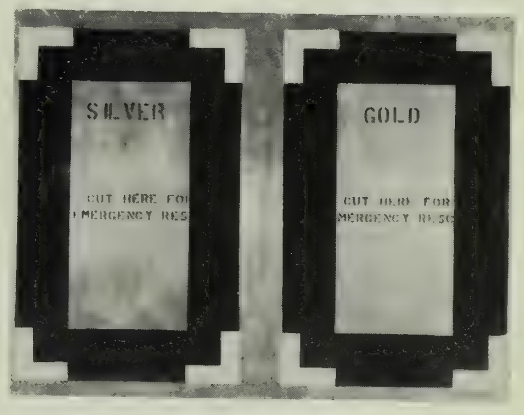
In August 1953 this squadron had the misfortune of suffering a major aircraft accident to one of its C-97s at Keflavik, Iceland. The plane crashed on landing and immediately was enveloped in flames. Rescue attempts of the personnel aboard were hampered greatly because the rescue team couldn't locate the emergency "cut here" escape panels. Three attempts were made before rescue was finally accomplished. It was dark and each time the firemen cut into the skin of the aircraft, they'd strike a stringer or beam of the fuselage. Although escape was finally successful for the three members of the crew entrapped in the plane, time available to them will not always be there.

Since this happening, the 31st AT Squadron has been experimenting with reflection tape to outline the yellow "cut here" corners of the escape panels. In the picture here, the panels marked "silver" and "gold" have backgrounds of black paint to cut down reflection of the aircraft skin during photography.

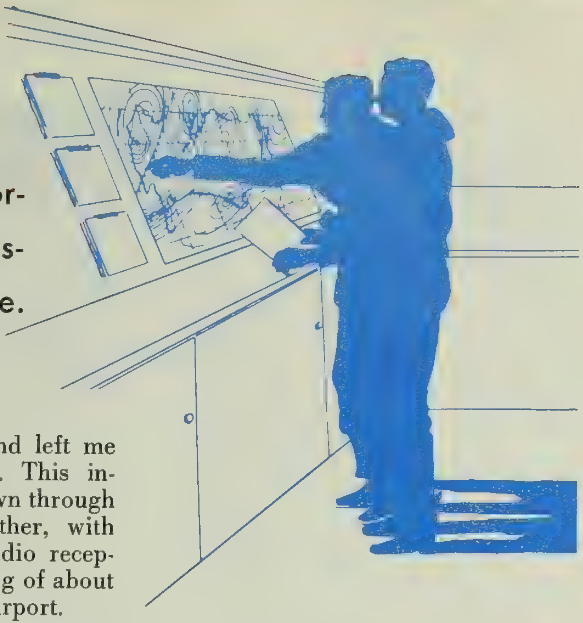
The tape used is not the red color that is found on automobile rear bumpers; it's either gold or silver applied with an applicator material which has been found to withstand weather, sun and aircraft washings.

Like the 4th TC Squadron, we of the 31st, equipped now with C-124s, feel that our project is an added safety feature and should be included on all aircraft in today's bigger and safer Air Force.

**Maj. William E. Yeates**
**Commander, 31st ATS(H)**
**Westover AFB, Mass.**



# T-Bird in



**What happens when a pilot gets caught in a tornado? A veteran USAF pilot answers this question with a factual account of his own experience.**

*Flying Safety Magazine believes that this story is of significant import to all USAF crewmembers. To our knowledge this is the first time a pilot has made a successful evacuation of an aircraft when in the middle of tornadic activity.*

*Col. Harrison Thyng told this story to Flying Safety Magazine in the belief that his experience should receive the widest possible dissemination in the USAF. In view of Colonel Thyng's extensive flying background as a fighter pilot in WW II and Korea, his recommendations aimed at precluding a recurrence of this accident are particularly valid.*

★ ★ ★

I'VE always heard that cats are supposed to have nine lives, and maybe that applies to pilots, too. Possibly not nine, but two or three anyway. Now I'm beginning to wonder how many I have left.

I remember the day that I suddenly found myself in mid-air without an airplane. That was during World War II, when people were playing for keeps. Somebody got a bead on me and literally blew my airplane apart, and there I was, tumbling through space and wondering what had happened to my plane. I could visualize a Kraut gun crew congratulating each other on some fine shooting, but soon I forgot the enemy for a moment and got busy and opened my chute.

About a year ago I used up another of those multiple lives when the engine of a Mustang quit and left me with nothing but trouble. This included an instrument letdown through 21,000 feet of solid weather, with severe icing, almost no radio reception and an *estimated* ceiling of about 700 feet at the Cheyenne airport.

Why didn't I jump? Well, I've spent years trying to perfect myself in the art of good instrument flying. I knew exactly where I was and felt thoroughly competent to make a precision letdown to an altitude where I could restart the engine and then continue on in. I felt sure that I had allowed the mill to ice up and that as soon as I got down into warmer air it would be easy to get it going.

That just goes to show how wrong a guy can be. Try as I would, I couldn't get even a burp out of that engine. At 2000 feet, just as I was getting ready to leave the Mustang, a hole opened up momentarily and I got a glimpse of the ground. There was a beautiful four-lane highway below. "That's for me," I said and kited the old '51 up on a wingtip and went cranking down.

Old Lady Luck was riding along on that flight, too. Just as I broke out in the clear at 700 feet I got a quick glimpse of a runway almost directly behind. I still had a hatful of speed so I yanked the plane around in a fast 180 and aimed toward the near end of that hard-surface strip.

I came over the fence at about 50 feet, slammed the gear handle down and hoped. Just as the wheels touched, the down-locks chunked into place. I got the plane stopped and let my breath out. This was the Cheyenne Municipal airport!

Maybe you've already guessed the source of my trouble upstairs. It wasn't ice. It wasn't lack of fuel. It was one of those things that make corpses of pilot-type people. Somebody had forgotten a cotter pin in the throttle linkage system, right at the carburetor. The nut vibrated off, the bolt fell out and that, to coin a phrase, is all she wrote.

After this episode I decided that I would play it a bit cool. There are certain limitations to both men and machines and they must be observed. Careful flight planning and careful preflight inspections all point to greater flight safety. I began to take these two factors more seriously than ever before.

Just recently, after I thought my luck had just about been used up, I managed to get involved in a jet, right in the middle of a tornado.

The flight started late in April of this year, from Wright-Patterson Air Force Base. I was attempting to get back to my home base, Hamilton Field. I was with Major Hubert C. Vantrease in a T-33. We could not

# Tempest....

As told to FLYING SAFETY by Col. Harrison R. Thyng
Deputy Chief of Staff/Operations, WADF, Hamilton AFB.

clear direct to Denver and then to Hamilton since headwinds were forecast as being too strong, so we decided to go into Omaha, Salt Lake and then Hamilton. However, when we started to plot the weather changes it was determined that Salt Lake would be under poor instrument conditions for a letdown by the time we would arrive there, so we decided to fly the southern route.

We were assured at Wright-Pat that the weather was absolutely fine for Oklahoma City, so we took off. Major Vantrease flew to Tinker.

About half way between St. Louis and Tinker, we received a report from St. Louis radio that a tornado was southeast of Oklahoma City, moving northeast. We plotted this on our maps and decided that it would still be best to go on in, as planned.

En route we checked in with Springfield and Tulsa radio and both reporting stations assured us that the weather at Tinker was still good. As we passed Tulsa we could see the base, and just southeast of the field was a tremendous black cloud. It looked like a huge thunderstorm.

We arrived without further incident, refueled, had a bite of supper and then checked the weather.

The storm that the forecasters were watching very closely on their scopes, was still to the southeast of the base.

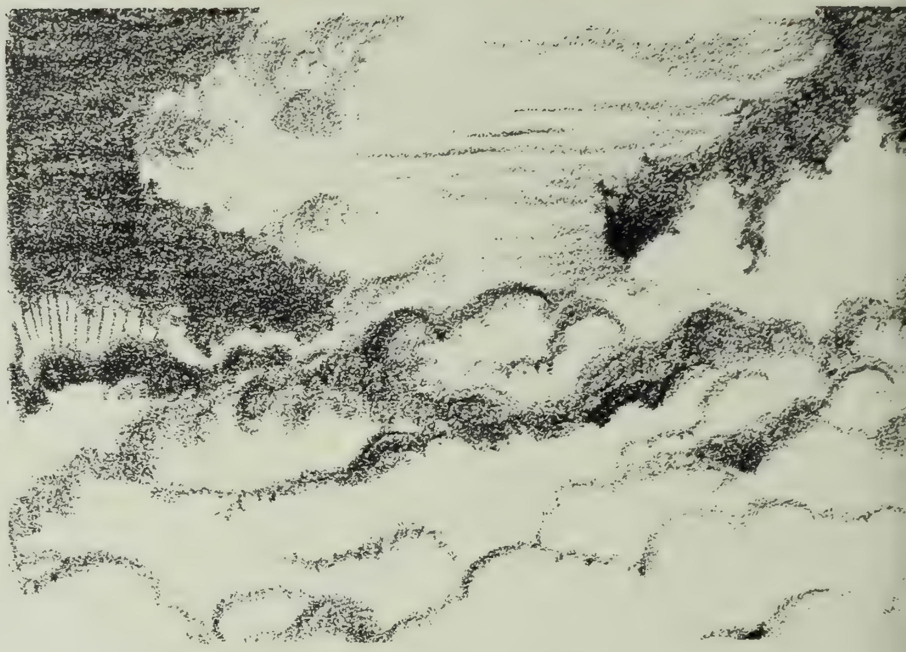
As it was my turn to fly, I took off and stayed VFR until we'd gone about 10 miles west of Oke City and then climbed up through the overcast, as specified by our IFR clearance, to get on top. At 21,000 feet we were not on top and the radio static was very bad. I tried, but could not contact Oklahoma City Radio.

At about 24,000 feet we were suddenly in very, very dark clouds. We had been flying on instruments without cockpit lights, but now they were necessary. This was about 1920 hours, and we were starting to get what we then considered to be thunderstorm turbulence.

The instruments were steady as a rock. We were climbing at about 240 knots and both turn and bank and gyro horizon were as they should be. However, the rate-of-climb pegged itself at 6000 feet per minute, *UP!* We could feel the tremendous updraft.

I had both my hands on the stick and had my harness and belt tightened up, expecting very shortly to hit a downdraft and then be in the clear.

We'd been airborne then about 20 minutes, so we must have been about 80 to 100 miles out and I felt by now we should have been VFR.



**". . . we received a report from St. Louis that a tornado was southeast of Tinker, moving northeast."**

At this time the airplane suddenly snap-rolled to the right and then continued into a series of very violent snaps, first to the right and then to the left. Next we found ourselves in what appeared to be a crazy twirling motion maneuver.

Incidentally, we definitely were not spinning; a twirling or twisting motion is the only way I can describe it. Strangely enough the instruments were still indicating normally except for the rate of climb and the altimeter. The latter was showing a decided drop in altitude, although the rate-of-climb was still holding at 6000 feet, up! I couldn't understand how there could be such a tremendous pressure change so quickly.

Along with the twirling motion, we were still getting those violent snaps that threw us around in the cockpit. This was certainly the strangest maneuver I'd ever been in, and I've flown through many thunderstorms.

Major Vantrease, in the rear cockpit, asked me if I thought we should blow the canopy and said he thought we had received some structural damage to the aircraft. After a few seconds I answered him and said, "Van, I think you'd better blow the canopy, and if this continues, you get out of the airplane whenever you want to."

Somehow, he was able to reach up against the tremendous G forces and actuate the canopy jettison system. The moment this was done, we lost our helmets and oxygen masks. This was between 20,000 and 25,000 feet.

We were still experiencing this twirling motion and then the plane would suddenly snap and then keep snapping. I was fighting the controls and trying to fly the plane when it suddenly flamed out. This was undoubtedly due to the tremendous negative G forces that we were being subjected to. I do not believe any airplane could have withstood such stresses without flaming out.

I was finally able to roll over into what I thought was a level attitude. However, I couldn't hold any semblance of an upright position, because the plane, in spite of control pressures, would snap first to the right and then left. But, between rolls I managed to get my fingers on the airstart ignition switch. I was able to get my left hand from the throttle just long enough to throw it in. We immediately got an amber warning light, indicating a hot start, for I had not been able to get the throttle in the cut-off position or know whether or not the tailpipe had drained at all. But, in spite of the hot start we did have power again. I hoped now that we could push ourselves through this terribly turbulent condition.

However, it was of no use. The airplane was starting to break up and the hail was absolutely terrific in the cockpit. My face was being cut to ribbons. I couldn't see much, since

### About the Author

*Harrison R. Thyng was born in Laconia, N. H., on April 12, 1918. His flying career started in 1939 when he entered the cadets.*

*In World War II, as a squadron commander flying Spitfires, he knocked down eight German aircraft and later transferred to the Pacific where he bagged one Japanese plane.*

*In the Korean action, Col. Thyng became one of America's oldest jet aces, shooting down five MIG's, at the age of 34.*

*This story deals with another kind of enemy that he recently encountered. A deadly one, too.*

**"I took off . . . climbed through the overcast."**

my right eye was closed and the left one was simply a slit. I could just barely make out one or two of the instruments. We were unable to communicate with each other now, but I felt sure that Van was getting out. At about 10,000 feet there was a momentary lull in the turbulence and I sensed that Van was out of the airplane.

I now tried to eject myself but was unable to get my right hand off the stick and over onto the ejection seat handle. The centrifugal forces were so great that I just couldn't move in that cockpit. My left hand was still on the throttle, my feet were on the rudder pedals and I could not move them. Finally, I managed to get my right hand into a position where I could reach and catch hold of the seat handle.

I pulled up on the handle and immediately was blown out of the cockpit without ever squeezing the ejection seat trigger, to my knowledge.

As I hit the slipstream, the seat was torn off and I thought then that it had ripped off my parachute, too. I knew that I was tumbling violently and felt sure that I was falling to my death for I just *knew* that the parachute had been carried away with the seat.

The rain and hail sort of brought me to clearer consciousness for a few seconds and a tremendous flash of lightning revealed that my ripcord was hanging by my left side. I reached for the D ring, pulled it and was the most surprised man in the world when I suddenly felt a terrific tug on my shoulders as my parachute opened.

I started floating now, instead of falling, and the chute stopped a lot of the hail from cutting my face and beating into my eyes. However, the turbulence of the air kept me swinging in great arcs of about 180 degrees and the parachute was so wet that it would collapse as I was swung from one side to the other and then would puff and open as I'd hit the bottom of each wild swing. Because of the turbulence, the chute started to twist and twirl, and fight as I would, I couldn't do a thing about it. At this point I firmly believed I'd never come out of this nightmare alive.

Somewhere below, I knew the ground was rushing to meet me. I couldn't see it though, for both eyes had swollen shut, and it suddenly dawned on me that this billowing parachute was just prolonging the inevitable. I *knew* that my number had finally been called.

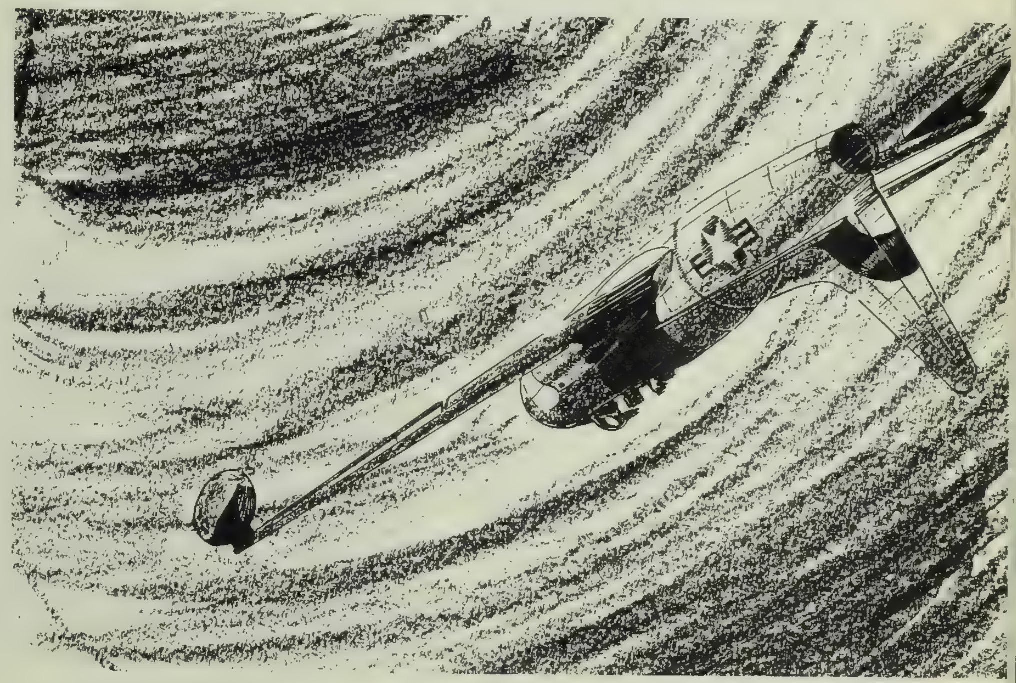
Suddenly my feet slammed into the ground, followed immediately by the rest of my body. This, of course, was no controlled landing, and I had the wind knocked out on impact. It felt as though a Missouri mule had just kicked me in the back.

In a couple of moments I got back a bit of wind and tried to stand up. Just as I staggered to my feet, the wind in howling fury snatched the parachute, and for the next minute or two I was dragged first one way and then the other. I didn't have a quick-release harness and probably wouldn't have been able to use it anyway, unless it had been a chest type.

I finally managed to release the chest strap and right leg snap and then was able to slide out of the harness. I stood up and was gratified to find that I could walk, but it was a supreme effort, believe me.

Fortunately, I had a bit of vision left in one eye and through the darkness saw a light in the distance. How far, I had no idea. I guessed that it might be a quarter of a mile or so. My guess was pretty good at that but I did a great deal more staggering

**". . . we definitely were not spinning; a twirling or twisting motion is the only description."**



". . . I did more staggering than walking before I got to the house, the journey seemed endless."

than walking before I got near the house. Distance doesn't mean much in the middle of Oklahoma under normal circumstances, and now this journey seemed endless.

Reaching the ranch I knocked on the door but received no response. No human response, that is. Two dogs suddenly appeared from out of the darkness and both tore into me viciously, barking and snapping and lending nothing to my peace of mind. I guess the scare must have given my system an additional shot of adrenalin for I was able to muster enough strength to kick them away a couple times before my beaten and bruised body gave way.

At this moment, I heard a shout and a man appeared from around the corner of the house. He ordered the dogs off and then approached me cautiously. Not that I blame him. Between the darkness and my bloody appearance, I must have presented a rather gruesome spectacle.

Even after he got close to me there was some doubt in his mind as to whether or not I was a human being. My face was so cut up and swollen I'm sure I would have scared most anyone. Evidently this gentleman had never been in the service for he did not recognize my flying gear. I tried to explain to him that I was an Air Force pilot and had just bailed out of a jet. I told him that I just wanted to use his telephone.

He was still undecided what to do when his wife appeared. They both had been holed up in their storm cellar, waiting for the tornado to go on past. She took one look at me and decided that I needed medical attention right away. She, bless her heart, told her husband to get me in the house and immediately turned to and started to heat some water on the old country stove.

After the water was warm, she bathed my face as much as I could stand, but every touch of the wet pads brought on excruciating pain from the cuts and bruises inflicted by the hail. But, it was a wonderful relief to be in the care of human beings.

I asked again about a phone. They both told me not to touch the instrument. The bell kept jangling and they said that lightning was keeping the line too hot to make a phone call safe. Probably they were right, too.

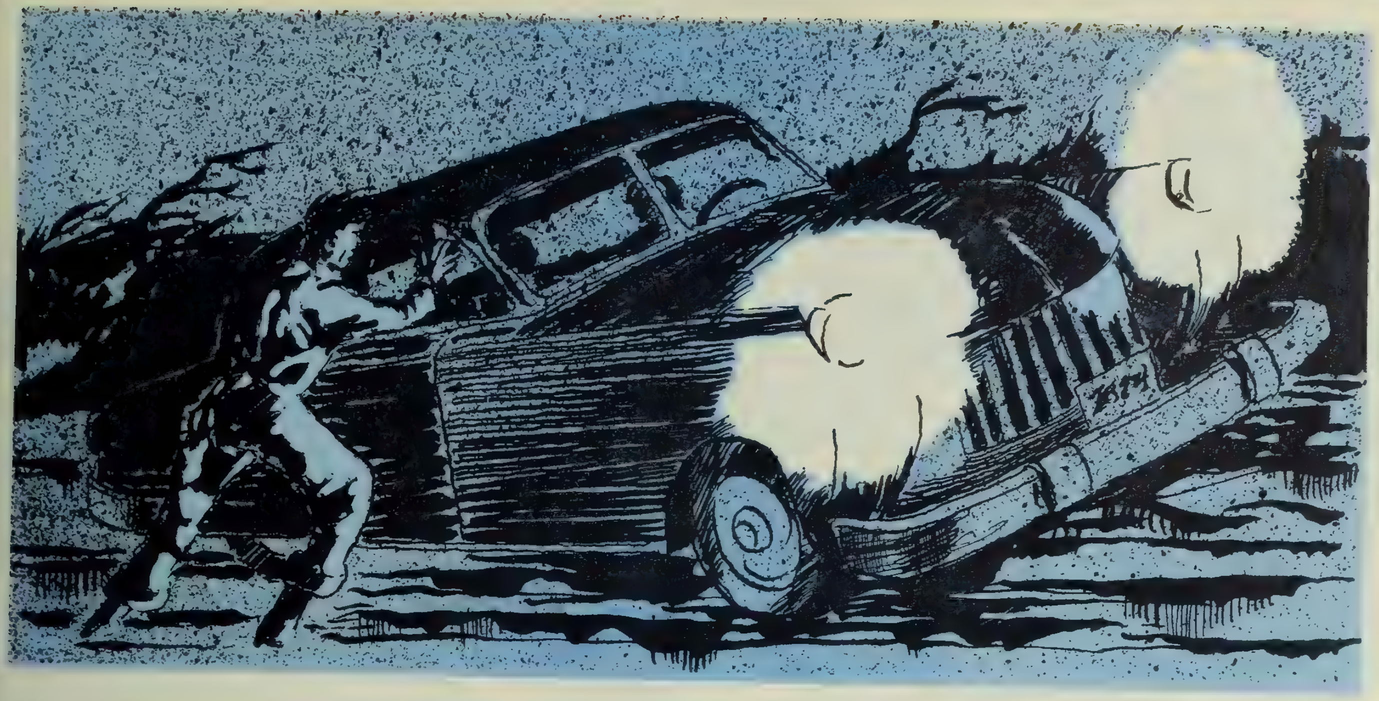
About this time I began to wonder if we all shouldn't be in the storm cellar. The wind was screaming around the corners of the house and great sheets of rain were slashing across the open country like waves of the sea. I guess I was still too dazed to realize that I'd chuted down in completely impossible weather.

They dug out some dry clothing for me and the man of the house helped me peel off my soaking flight gear. Every move I made hurt a great deal but I finally got through that change and immediately began to feel better.

They told me it was eight miles to the nearest town and, in spite of the weather, insisted that they were going to take me to the hospital. My protests did no good and soon they had me loaded aboard their old automobile and away into the wet darkness we chugged.

The first two and a half miles were hellish. Between the crowned dirt road and the mud and the rain it was impossible to keep the machine in the rutted tracks. It would slip and slither toward the ditch each time the rancher let out on the clutch. Finally his wife took over the wheel and he got out and pushed and steadied the car until we got to a hard topped highway. For two and a half long miles he tugged

". . . two dogs appeared from the blackness, and tore into me viciously, snarling and snapping."



". . . for 2½ long miles he tugged and strained and pushed to keep the car going, while I sat inside, miserable and ashamed that I couldn't help."

and strained and pushed to keep the car going, while I sat inside, miserable and ashamed that I didn't have enough stuff left to be out there in the rain helping him.

Finally, after what seemed hours, we chugged into Weatherford, Oklahoma, where I was promptly hustled into the hospital. There, I was able to get a phone and report my plight to Tinker AFB. Immediately thereafter the hospital attendants bundled me into bed where I rather ungracefully, but thankfully, collapsed.

Although I haven't mentioned it so far, you may assume correctly that I had been doing a great deal of speculating and worrying as to the whereabouts of Major Vantrease. My benefactor at the ranch had immediately discounted any suggestions of search that night because he knew that once away from the farm, the chances of getting back again would be almost nil. I had no idea whether Van had bailed out immediately before I had ejected or whether he had managed to get away long before. Somehow I had faith that he was down and safe, but where I had absolutely no idea.

The next day I learned that Van was safe and in a hospital at Clinton, Oklahoma. He had landed about three miles from where I touched down so he must have gotten out of the plane just seconds before I went.

Later he told me that somehow he had slipped from the sling of his chute just before landing and then slammed into the side of a hill and had hurt his back. He found he was unable to walk, though he could see a light in the distance.

He realized his injuries precluded further movement so he wrapped his chute around himself and sat it out for the rest of the night, shivering and cold. Toward dawn he could make out a nearby highway and finally crawled to it and succeeded in stopping a passing motorist, who took him to the Clinton hospital.

Well, that's about all there is to tell. We both healed and mended in short order and were glad to get another plane and hop home. I'll clarify that statement. It was good to be flown home! It is better yet to be flying again, myself.

You're probably wondering how I feel about tornado flying. That's an easy one to answer. Flying hasn't changed a bit. Neither has my love for it. I can say though, that from here on out I'll know that it is impossible to fly safely through areas of tornado activity. And this statement includes *all* pilots, regardless of experience level.

Naturally after an experience like this I have reached some firm conclusions that I'd like to pass on to other pilots and operations personnel.

- In areas of great seasonal unstable weather conditions, special emphasis should be placed on obtaining an adequate weather briefing by the pilot. I was my own clearing authority as a green card pilot. To my regret I signed off the weather section of Form 175 as "Weather Checked by Pilot." I recommend to all pilots, including those with green cards, that they have competent Air Weather Service personnel fill in the weather section for them. Then there can be no misunderstanding. If necessary, I'd like to see an extra forecaster on duty during periods of extreme weather conditions.
- A pilot should remember that while flying at dusk, during the hours of darkness or within thunderstorm areas, it will be impossible for him to see a tornado; consequently he can inadvertently fly right into one. If there is a possibility of tornado activity, it is best to wait for an improvement in weather along the proposed flight route.
- If a pilot is flying in or through an area for which tornado activity is forecast, he should not assume that every black cloud is just a thunderstorm. Play it safe and do one of two things: Either climb above such activity while still in the clear, OR make a 180 degree turn and get out of the area, right now, before actually making a penetration. It's that simple. Don't do what I did.
- I would like to stress the value of proper protective clothing. My flight jacket really helped a lot. I was wearing a regulation jacket over my flying suit and as always, was wearing gloves. As a result of such protection, my hands, arms and upper body suffered almost no damage from hail. Major Vantrease, on the other hand, was considerably bruised over these same areas. His only protection was a light flying suit. ●

# MAY I RIDE WITH YOU?

**Non-rated passengers have an interest in the flight, too. Sometimes they wonder when faced with the non-briefing, get 'em aboard, let's go type crew.**

I'M a ground type, ground pounder, paddle foot...I'm non-rated. Why? Because some flying instructor back in 1940 told me after 10:28 hours of PT-17 time that I couldn't hit the ground with my hat—let alone land an airplane. I met the board. They said it's been nice and thanks, but no thanks for any more. But I had the last word.

"Yes, Sir."

Come fall this year I'll have 14 years in the Air Force, a comforting rank, and—in the ZI and overseas—a lot of passenger flying time. A little in jets but mostly in gooneys, B-25s, C-45s, T-6s, C-54s, B-17s, C-121s, C-74s, L-20s and the likes of that. Some years I averaged 12 to 15 hours a month in the blue on various TDY assignments.

I've ridden with all types of pilots and aircrews. Today I have a clear-cut picture of the guys I like to ride with and an equally vivid memory of those who made me wish I'd been shopping with the wife—something I detest.

Suppose you are flying to Timbuctoo tomorrow. I call you the day before the flight to find out if you have room for me.

You say, "Be at operations at 0615."

I show up at 0600 and find you've already started your clearance. This I like (and I know you like my being there early). I've come to respect the pilot who has set a takeoff time and expects to meet it. The entire ride will reflect the same precision. You ask me if I care to get the weather with you. I chalk up another bonus point because you're the type who appreciates the interest every passenger has in the entire flight plan.

I realize, by the way, that passengers are not ordinarily allowed in either ops or the weather office. Hence, I don't expect the plush treatment and accept it only on invitation and when I won't be adding to the confusion.

...EVER SEE A CHUTE BEFORE?

The paper work is all handled and we walk out to the airplane. You introduce me to the rest of your crew and that's important to me . . . that personal interest in the people I'm sharing the adventure with. The opposite, all too familiar scene goes something like this:

"Who is going on 3256? Joe, have you got any maps? Who has the clearance? Sergeant, how many 'chutes are there? Let's leap."

Brother, think I, this is another one of those real gone rides. They want to get off the ground before someone cancels their cross-country. That gal simply will not be kept waiting. Bet they want to get us peasants off at the first stop.

This isn't meant to be the latest chapter in Emily Post on the niceties to be observed when traveling by military air. Rather, it's another impression to help define an attitude or frame of mind that ultimately adds up to the professional airmanship we all respect.

But to get back to where we were walking out to the airplane. I follow you around as you make a visual inspection. You pay particular attention to the controls, step up on a tire for a close look in the wheel well. I don't know what you're looking for but I'm becoming confident that you do.

Before starting engines you get the attention of all the passengers and explain the flight plan. The crew chief begins passing out the parachutes. You ask everyone to try his on.

The Sergeant says, "Colonel, your leg strap is a little loose. May I tighten it for you?"

He helps me and I think, "They're leaving nothing to chance. These guys are good."

"How many of you have ever used a parachute?" No reply.

"I've never had to jump either, but here are some things to remember. Keep your head down when and if you jump. Look at the D-ring, but don't put your hand on it until you're out. Turn around and watch the plane, a gimmick to assure that you are well cleared. You know how to turn over in the water while swimming. It's just the same in the air. Twist your body and you'll turn. Keep your feet together. It keeps the shroud lines from between your legs."

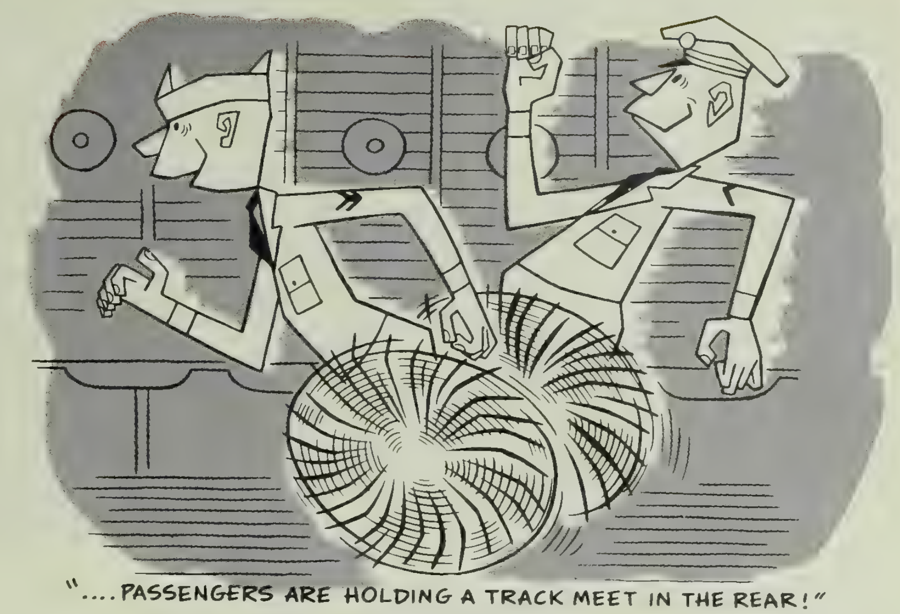
After this he continues through the routine and then explains alarm signals, emergency exits and procedures.

I have never been comfortable with an aircraft commander who takes all these explanations for granted . . . anymore comfortable than I would be on a ship that failed to pull the customary lifeboat drill. I've been through the procedures many times and I want to hear them many times again. Not so much for my sake after all these years, but for the benefit of the young clerk-typist who is going home on his first leave; the cute little WAF with the engagement ring (somebody should have told her about parachutes and skirts); and the sailor going to Kentucky after two years of sea duty.

Sure, all of us like to act like seasoned space hoppers. *Ever heard a passenger ask for a briefing on emergency procedures?* Down in the heart we know something is missing when the commander does not solve the mysteries that each passenger is thinking about.

A little knowledge is a hazard to a ground pounder's peace of mind. He learns a smattering about engines, about flying techniques—picks up a little weather lingo, realizes that there is an air traffic control agency, that some planes fly farther on a given amount of fuel than others and that there are needle-ball and airspeed indicators plus a gaggle of other gadgets and gages to make like a bird. Most of all he knows that there is a lot he doesn't know and hopes and trusts that the crew does.

Flying along, do you sometimes put down the magazine you're reading and begin wondering about it all? Especially when everything shudders in a steep climb or turn, when the props get out of synchronization, when power and pitch settings suddenly change, and when the furniture for the new NCO club stampedes down on you in severe turbulence (this has happened).



"....PASSENGERS ARE HOLDING A TRACK MEET IN THE REAR!"

When these random thoughts pass by, you realize that you are automatically doomed to the uneasiness which a little knowledge breeds.

Little things count . . . like seeing the pilot walk back occasionally. On a recent flight on a foreign airline my seatmate, obviously a well-traveled European, said "What I don't like about this airline is that I never see the Captain. I like the airline where the skipper introduces himself to the passengers, tells about our flight and then tells us each time he makes a change."

His remarks reminded me of another airline that attached to my timetable and ticket a booklet that explained why the atmosphere is sometimes rough and compared its effect on an airplane to a ship in heavy seas.

All this adds up to confidence in the equipment and the people. You say, "You're getting a free ride—you want a free book too?"

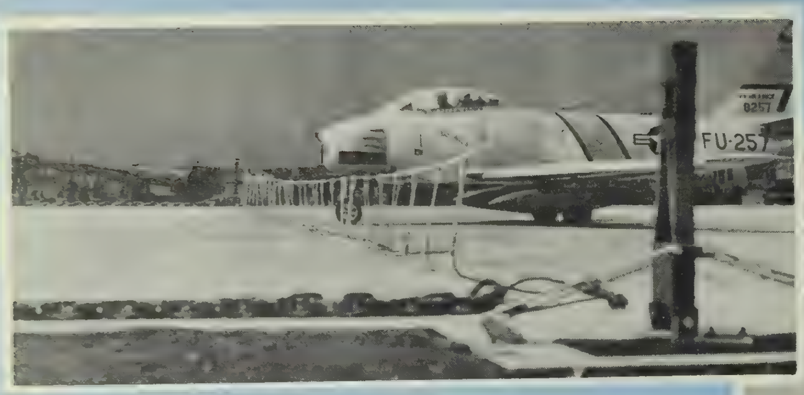
No, but I figure the effort the commander takes to let his brood know he's aboard and really in command shatters uneasiness, and reflects well on himself and my branch of the service. Should an emergency arise (this his happened, too), the confident group of passengers will be less a problem than a group that was mystified and perhaps slightly apprehensive at takeoff.

I have also come to appreciate that aircrews make equally valid observations of their passengers.

I wince with the aircraft commander when passengers expect his crew to hop bells for baggage; suffer with the pilot who keeps one hand on the elevator trim because passengers are holding a track meet in the rear. But most embarrassed am I with the rider who thinks safety belts are for sports cars, parachutes for a beautyrest and Mae Wests a cushion for precious personal baggage. Another pet peeve is the sick passenger who's ashamed to reach for a paper bag—or even his hat—and the matador who gets that gored expression when told to quite monkeying around with the door handle.

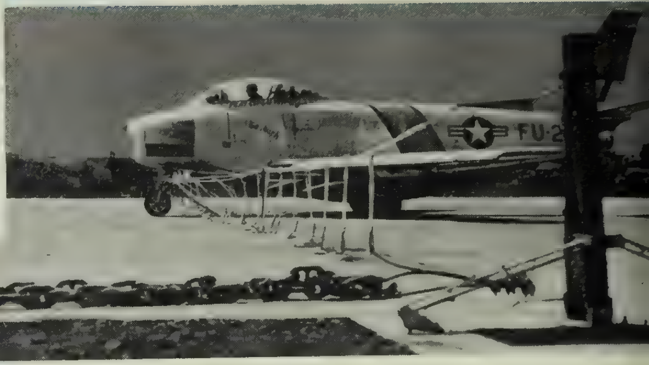
The above statement is written for the benefit of all us types that frequent the passenger lounges, asking the proverbial question, "May I ride with you?" Bargaining that the travel time we save is worth taking on any and all comers as a crew and not always appreciating the usually competent airmanship that gets us from here to there. ●

YEAH—I'M YER PILOT... LE'S GO



An F-86, moving down the runway at 140 mph, is shown about to make initial contact with nylon webbing of the landing barrier.

Nose gear has gone through barrier, triggering arresting cable which will spring up to engage the main gear of the plane.



# Ask The Man Who HITS One!

The Korean War established the value of the jet barrier. Now a unit at Nellis AFB shows how it has saved defense dollars.

*Barrier!*

That's a word that is coming into everyday usage more and more. You mention barrier to hot-rock Charlie or John Q. Public and they both think of that invisible wall. The sonic barrier is fast becoming an open door in spite of its name.

There is another type of barrier though, that isn't quite as well known, and this one is plainly visible. These barriers, unlike the sonic type, do not present any particular problem when an airplane slams into them. It's exactly what they are intended for. As a matter of fact, driving headlong into one of these arresting gears can mean the difference between a successful stop or a badly mangled aircraft. That is, if a pilot overshoots a flameout landing, suddenly runs out of brakes during the landing roll or happens to lose the fire-pot on a takeoff.

In terms of dollars saved, the few units now in operation have paid for themselves many, many times over. Within the next few months many new ones will be springing up all over the world until eventually almost every USAF air base will be sporting such accident prevention devices.

Recently FLYING SAFETY was alerted to the fact that Nellis AFB had started a barrier program. While not the first, it is one of the first in the ZI. Consequently, we elected to give their unit a look-see.

The Flying Safety Officer, Major Hugh Bodiford, jumped at a chance to extol the virtues of their glorified tennis net. We say "their" advisedly, for with the full approval and backing of Crew Training Air Force and Brig. Gen. James E. Roberts, Commander at Nellis, base personnel managed to push through the construction of their first barrier.

The Korean conflict had established the value of barriers. As a fighter pilot in that theater, Bodiford was familiar with the operation and capabilities of such units. Upon his return to the States and assignment at Nellis, he was determined to get a similar program going.

It wasn't easy at first. There were many obstacles. It took a lot of scrounging to dig up the necessary materials. Fortunately, the U. S. Navy came through and made it possible for Major Bodiford to secure many necessary parts for the first barrier.

It is interesting to note that as this issue goes to press, five aircraft have been saved from almost certain destruction by the Nellis barrier. Add that up in good old dollars and you'll see that the $5,000 or so spent on its construction is but a drop in the proverbial bucket.

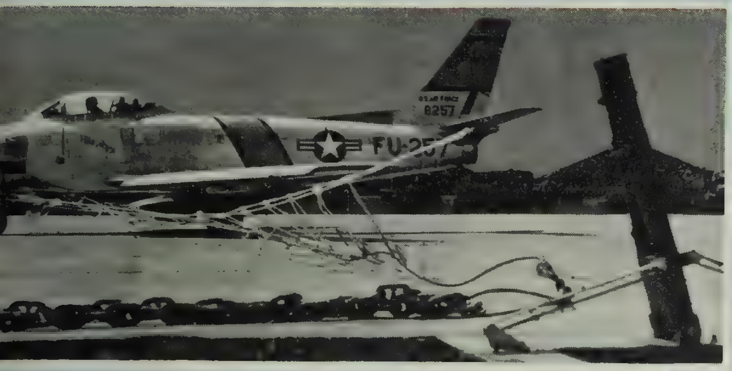
We do not intend to go into any of the finer details of the emergency arresting gear in this article. That is strictly an Air Installations problem and will be so handled by bases scheduled for these units. However, we do want to alert pilots of fighter aircraft to the fact that an extensive program is already under way and point out a few operational factors that are worth remembering.

### Main Barrier Features

A brief rundown on the main features of the barrier should help to better understand its operation.

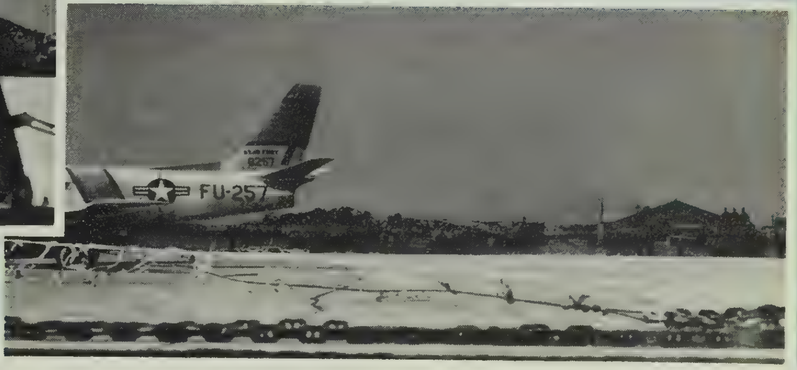
In general, the following components make up a typical arresting gear:

*Webbing Assembly:* This assembly consists of an actuator strap to which are attached a number of vertical lifter straps. Each lifter strap is rigged



Nylon webbing is torn away and arresting cable has now made contact with the main landing gear, reducing the aircraft's speed.

With arresting cable now pulled taut, the F-86 begins to drag the heavy, linked chains stretched along the sides of the runway.



to the arresting gear cable by means of six special lock type snap fasteners. These fasteners are capable of carrying a high load. The restraining strap, which is secured to the anchor end of the vertical lifter strap by two conventional glove type snap fasteners, is incorporated as a part of each lifter strap to insure that only a load of high magnitude will have a tendency to open the six main fasteners.

Five gets you ten that we lost you on that one. But, as it's not our intention to add confusion to this article just think of a nylon net, anywhere from 150 to 400 feet long and 40 inches high. That is a rough picture of the webbing assembly.

*Releases:* Two release devices are used to attach the ends of the actuator straps of the webbing assembly to the tension mechanisms of the arresting gear stanchions. A replaceable shear pin is incorporated in the release and upon shearing, the actuator strap is freed from the release assembly.

*Runway Anchors:* These anchors provide a means of anchoring the lifter straps to the runway. It is from these points that the restraining force is applied that unsnaps the six main fasteners on each lifter strap thus releasing the arresting gear cable during engagement.

*Arresting Gear Cable:* A flexible steel wire rope cable, ⅞ inch, uncoated, improved plow steel, fibre core, is utilized as the arresting gear cable. This is the little gem that snaps up and grabs the blow-torch firmly by the landing gear. Each end of this cable is attached to the arresting chains.

*Arresting Chain:* This is the part of the barrier assembly that does the actual slowing down and stopping of an aircraft. The chain is placed parallel to both sides of the runway. In the case of the Nellis installation, they are using 273 feet of chain on each side and as each link weighs 57 pounds, it is apparent that any engagement means dragging a lot of weight.

*Main Stanchions:* The stanchions mounted on concrete foundations, serve as end supports for the actuator and arresting cables. Each stanchion incorporates a hand operated winch for positioning and tensioning the actuator pendants. These stanchions, hinged at their bases, incorporate a set of bungee cords for damping stanchion motion and aid in raising or lowering the posts as necessary. The stanchions can be laid flat when the barrier is not in use.

The arresting chains are laid parallel to the overrun. At Nellis the 273-foot chain is made up of links each weighing 57 lbs., and over a foot long.

*Intermediate Stanchions:* The intermediate stanchions serve as support for the webbing assembly so that the actuator straps may be raised to a height of approximately 40 inches at any point along the width of the runway between the lifter straps. These intermediate stanchions are designed to collapse on engagement.

### Barrier Operation

You're probably wondering at this point just how this little beauty works. We'll try to keep it simple. Between this copy and the pictures, you should be able to get a pretty fair idea.

As the nosewheel passes over the arresting gear cable lying on the runway, the webbing assembly is engaged by either the nosewheel strut fairing or the nosewheel well doors.

Continued forward motion results in the arresting gear cable being lifted off the runway by four lifter straps in such a fashion that the arresting gear cable rises *behind* the nosewheel, but *in front of* the main landing gear.

The four active lifter straps continue to lift and pull forward on the cable until they are taut between the nosewheel fairing and the anchors. Further forward motion of the aircraft unsnaps the retaining snap fasteners, pulls the lifter straps through the inertia flaps, then unsnaps the six main snap fasteners attached to each lifter strap.

At this point, the arresting cable is off the runway, moving upward and slightly forward between the nosewheel and the main gear and is now completely free of the lifter straps.

As the aircraft continues forward, the arresting gear cable is engaged by the main landing gear struts and further forward motion is restrained by pull on the cable transmitted from the arresting chain. The airplane then progressively moves more mass by reeling out the heavy doubled chain during the remainder of the arresting run. We did a bit of research and asked a lot of questions on the actual operation of the Nellis AFB barrier. Here is a description of the five saves made there.

- The pilot of an F-86F started his takeoff roll as the No. 2 man of an element. He ran power to 98 per cent and went wheeling up the runway.

As the leader became airborne the No. 2 man noted that his plane was dropping back. He glanced at the tailpipe temperature gage and saw that it was rising above the red line (700°). The pilot immediately stopcocked the throttle and aborted the takeoff. The airspeed indicator was crowding 150 knots at this time.

As brakes were applied, the plane began to slow somewhat, but it was evident that insufficient runway was left for a safe stop. At 100 knots the F-86 slammed into the crash barrier and decelerated to a stop with only minor damage inflicted by the barrier cable. Chalk up one save for the runway arresting gear.

FLYING SAFETY does not propose to get into the cause factors of these cited incidents. The important thing is that the barrier saved these planes from almost certain destruction.

- The pilot of an F-86F was returning to the base from an air-to-air gunnery mission. His landing was fast because he inadvertently left the emergency switch in the standby position. This forced an idle condition of approximately 42 per cent and the pilot found it impossible to slow the plane to normal touchdown speed.

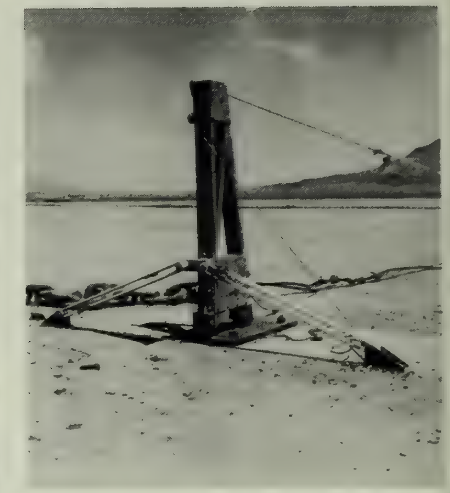
Mobile Control observing the fast approach, instructed the pilot to "take it around." However, on advancing the throttle a compressor stall occurred and a forced landing suddenly became a reality.

The F-86 engaged the crash barrier at an estimated 70 knots. Only the right gear connected with the cable but in spite of this the pilot was able to maintain straight directional control and the plane was stopped without any appreciable damage.

Chalk up another on the plus side for the crash barrier.

- The pilot of this F-86F was No. 3 in a flight of four Sabre Jets that had

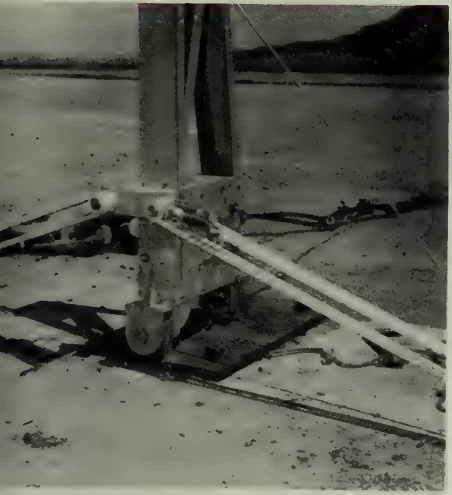
A hand winch is used to position the barrier.

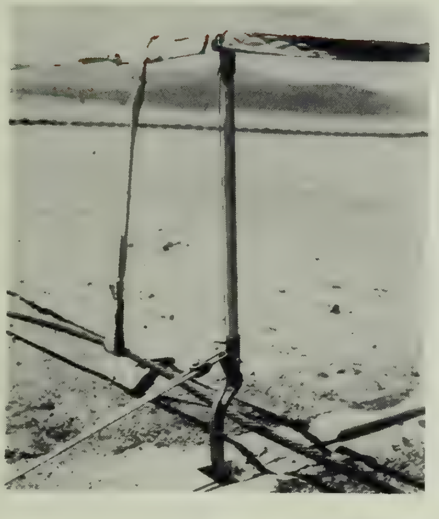

Stanchions serve as end supports for webbing.

Note arresting cable across main landing gear.

Aim for center of barrier to get best results.

Anchor, lifter strap combine to lift cable.


Bungee cords keep hinged stanchions upright.


Intermediate stanchions keep web 40" high.

just completed a routine training mission. His troubles began on the first landing attempt. Somehow he messed up the pattern and Mobile sent him around for another shot at it.

While tooling around the pattern on his second landing attempt, the pilot noticed that the throttle was not functioning properly. On final he discovered that power could not be reduced below 70 per cent rpm. This was like having the well-known tiger by the tail and from this point on the pilot was committed to land regardless of any personal desires.

The plane touched down at about the midpoint of the runway and went steaming into the barrier at 140 knots. It was stopped in less than 500 feet with only minor damage to the fairings. After the dust settled the pilot finally cut the master fuel switch to stop the engine. Obviously, the value of the Nellis barrier is increasing.

- This one was a bit different in that it involved a T-33A and the plane went sizzling into the barrier with the speed brakes down. Normally you'd expect the speed brakes to force the barrier cable down and below the main gear. Fortunately this didn't happen as the cable was forced downward and then snapped up again to engage just the tips of the wheel fairings. 'Twas enough though, and the plane was stopped successfully.

Replaceable shear pin releases actuator strap.

- In the fifth instance, an F-86 hit the crash barrier while traveling at high speed and a successful engagement was made. In this case, however, the pilot did not get rid of the external tanks prior to barrier impact and the arresting cable wrapped around the pylons instead of the landing gear, but damage was negligible.

## Quick Stop Tips

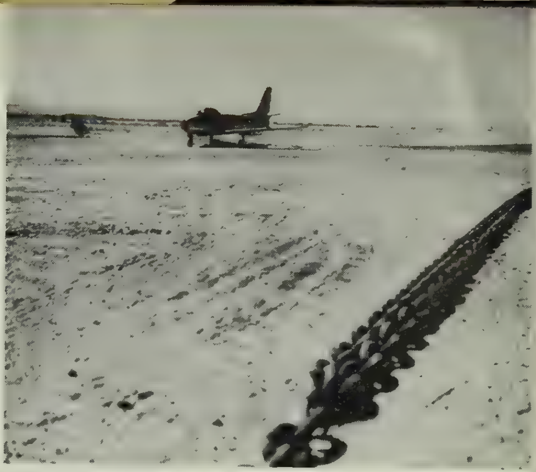
There are a few things that the pilot can do to insure maximum effectiveness when engaging the crash barrier:

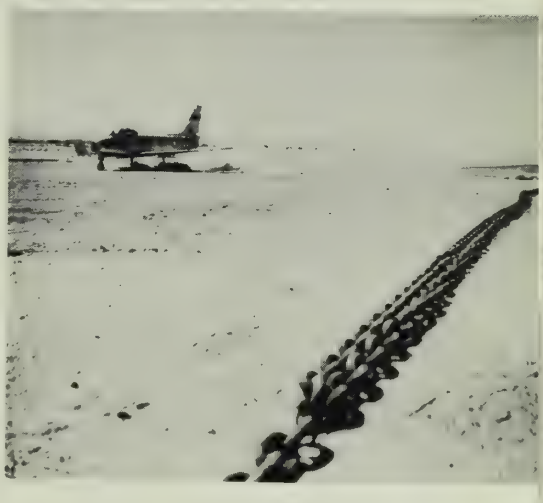
★ If an emergency develops in the landing roll-out or on a takeoff run, the pilot should make every effort to strike the center of the barrier, holding the airplane on a heading as closely parallel to the runway as possible.

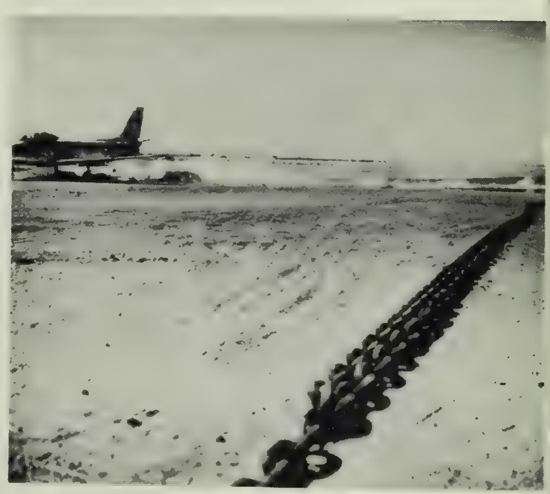
★ Excessive braking action to a point where a tire may blow out or the plane swerve should not be used as this may result in improper stopping action by the barrier. In other words, tests indicate that a high speed impact has a distinct advantage over a slow speed roll-in in picking up the arresting cable.

★ F-84s and F-86s with external tanks should be cleaned up prior to impact if possible, i.e., drop external tanks and stores.

★ Pilots flying F-80s, T-33s or other types with speed brakes located below the fuselage should make every effort to retract the speed brakes prior to impact.


Initial contact.


Cable hooks gear.


Plane drags chain!

Remember, the crash barrier will save the day for you in an emergency. Keep the few simple steps for engagement filed away in your mind. Work *with* the barrier when the chips are down and it'll take care of you. ●

# Desert Turkey Shoot

## JET WORLD SERIES

The 1954 Air Force-wide Gunnery Meet, held at Nellis Air Force Base, was entirely free of accidents both in the air and on the ground. This was the second time that such a record was established at Nellis and speaks volumes for all personnel participating in the meet. FLYING SAFETY salutes all who made this record possible.

Above, Luke Thunderbirds make a low-level, close formation pass by the reviewing stands.

Left, the Hamilton Sabre Knights thrilled spectators with exhibition of precision acrobatics.

Above, salvo of 12 rockets with warheads is on target in the F-94C firepower demonstration.

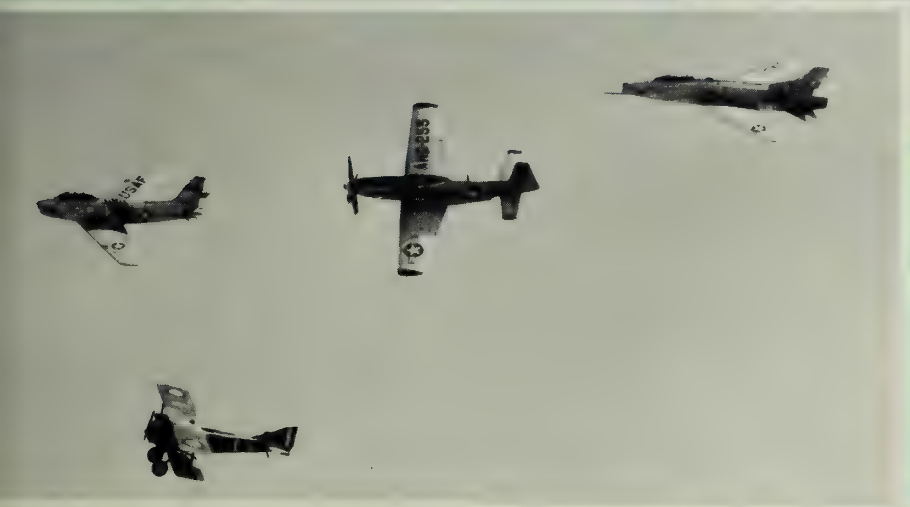
Above right, fire blossoms on desert when four 160 gal. napalm tanks, eight rockets let go.

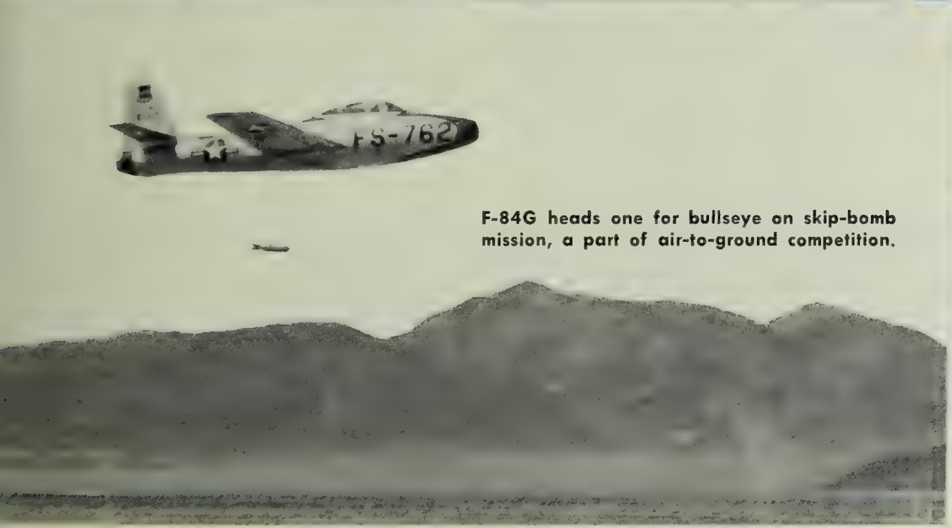
Right, F-86 jockey builds team points by being "in the bull" on low-angle strafing mission.

Left and below, F-84Fs impressed the crowd with a firepower demonstration which included napalm drops and rocket runs.

Above, the F-100 showed how it got the tag of "mach buster" by bouncing several booms off the hills from level flight. Below, Tony LeVier, flying the new T-33B, dazzled the troops.

Four generations of fighters spanning 36 years and three wars, are represented by 110 mph Spad, F-51, F-86, F-100.





F-84G heads one for bullseye on skip-bomb mission, a part of air-to-ground competition.

Below, rockets streak away from F-84F during "convoy attack" at the Indian Springs range.

# The SHORT BETWEEN . . .

### By CAPT. ALTON A. PENDLETON

"THE accident was caused by a short circuit between the stick and the seat."

This famous saying is widely known in both old and modern-day Air Force parlance, but few pilots really have taken the time to analyze the meaning. Just for kicks, let's make a short analysis of the 1954 military pilot. Normally this specimen is at his best when appropriately clad with red scarf, F-86 in vertical dive, power at 100 per cent and slapping sonic booms toward an unsuspecting public.

To start with, this fine specimen is composed largely of water, 87 per cent to be exact. That leaves 13 per cent minerals, providing we had the participation of the full 100 per cent to start with. In view of the high cost of living and inflated new car prices, he is valued at approximately $1.67. Considering the going price of today's modern aircraft, he has a terrific responsibility and, believe me, that is putting it mildly.

Now for the sake of the record we should make it very clear that the particular *type* of pilot we're analyzing is a real hot rock and admittedly a peculiar breed of individual. But, like the rest of us, he has discovered that although it isn't necessary to be nuts in this business, it helps. However, lest you leap to completely erroneous conclusions, this same mental attitude has been found extremely helpful in other lines of endeavor, such as zither stringing, swinett playing, chiropody or sausage stuffing. To each his own. So—back to pilots.

Let's consider some basic psychological factors. Stimuli and motivation are the primary factors in any individual wanting to be a pilot. Physical fitness, mental alertness and coordination (he can scratch his right elbow with his right hand . . . neat trick, mind you), give him the title, *Cream of the Crop.*

During pilot training, a student is concentrating on the basic fundamentals of learning to fly an airplane. The instructor pilot is pulling his hair (his own hair, that is), making decisions and doing most of the thinking. (We all have our problems.)

During this training process it takes concentration and repetition to learn good pilot technique. After a sufficient quantity of repetition the technique is mastered and becomes habit. This is a very important step. By the grace of God and these good flying habits, the student pilot graduates a 2d Lt. with silver wings. (Parade rest!)

After logging a couple hundred hours as a rated pilot and just when that new air-conditioned Buick is practically paid for, all might seem rosy; but, this is the time to beware of the aforementioned short between the stick and the seat. If a pilot is taught the proper habit patterns and how to apply them to his everyday flying, he will complete the circuit between the seat and the stick. But if the silver wings metamorphosize this student into a smouldering boulder in a couple hundred flying hours, it's Katie bar the door, we've got a stranger in our midst!

Under normal conditions an experienced pilot flies mostly from habit. A habit is a fixed way of responding. It is a definite way of reacting or thinking whenever the stimulus is given which usually touches off that particular way of responding. For example, two jet aircraft are approaching head on at high speed. Each pilot should *automatically* alter course to the right. That is habit.

We quote Charles R. Foster, University of Florida: "Thinking usually does not occur until the individual runs across some problem. He may become aware of a problem by many methods. Vision, sound and feel are some of the basic methods; therefore, if a pilot is alert, he will realize a problem exists in ample time to recognize it as such."

Solutions are the next step in thinking. After a problem has been felt or recognized, then comes the act of considering possible answers or solutions. Those pilots who are unfortunate enough to have met an accident investigation board probably can tell you: "The board thought of 19 solutions and I thought of only one." Namely, notify the tower and proceed to PRANG.

The accident investigation board has the advantage of time and knowledge. (Also technical data for research, if necessary.) The pilot is further handicapped by emotional stresses. Let's face it. It is the pilot's responsibility to know the answers and to be able to cope with any situation or emergency that may arise. (Needless to mention, his safety depends on completing a good circuit between the stick and the seat.)

Maybe we've sounded as though we were kidding a bit in this article. In a sense we were. Sometimes we all need a dash of humor to spice up a particularly serious subject and this business of flight safety is genuinely serious. We do urge you to remember this; no matter whether you go tooling around the blue in a blow torch or a frantic palm tree, *you* are the connection between the seat and the stick, so, DO be a good connection.

Knowledge is your salvation. Know your aircraft. Know your procedures. Know your limitations. Form safe flying habits and keep current.

Note: Any reference toward heads up and locked accidents, living or otherwise, is purely intentional. ●

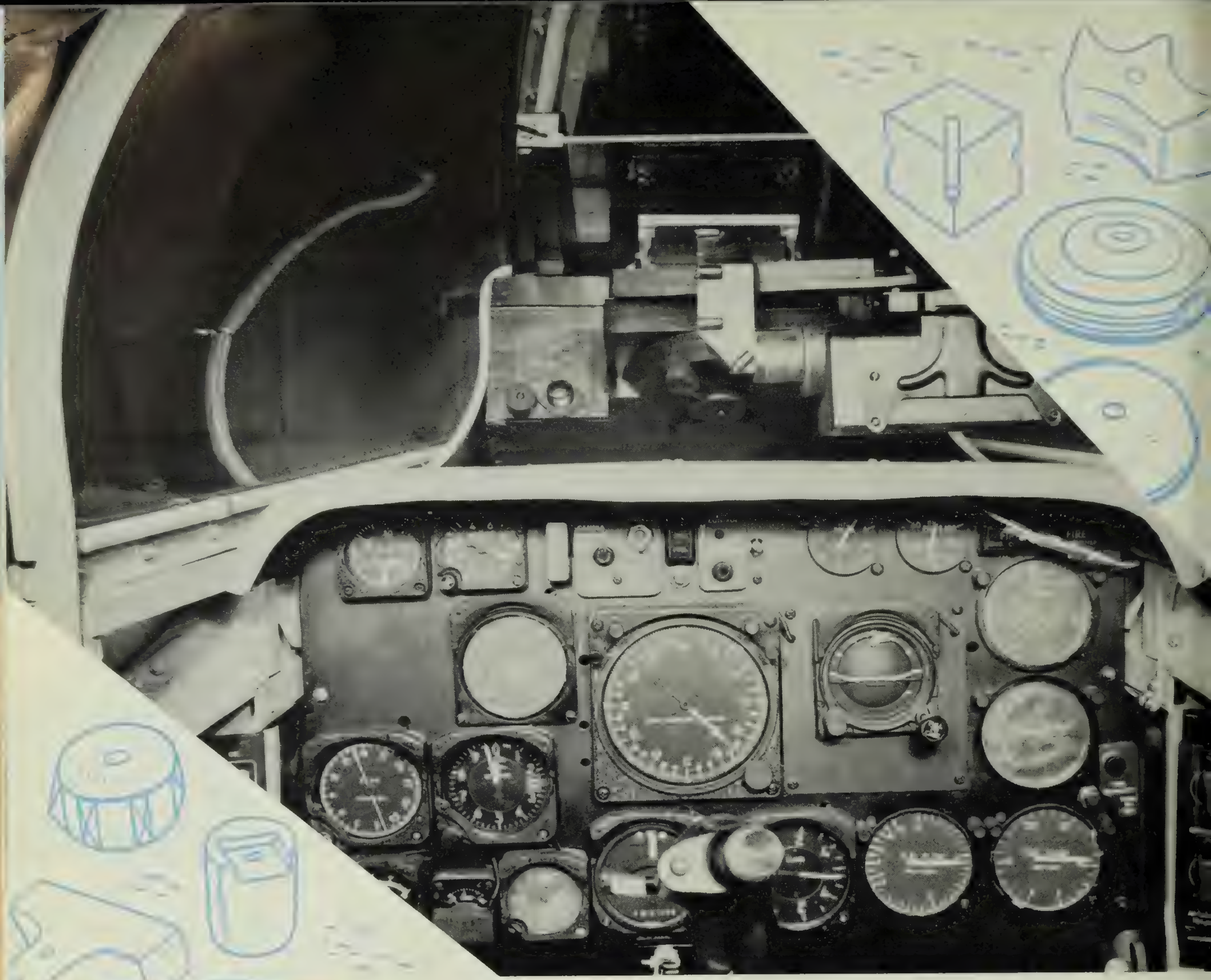
# WELL DONE

### Capt. Samuel W. Tyson, Aircraft Commander, 374th Troop Carrier Wing (H), FEAF

WHILE flying a C-124 on a passenger run, Captain Tyson was informed that the No. 1 engine was running rough, with a 50-pound fluctuation on the fuel flow meter. After he went to the engineer's panel to check on the engine, the roughness increased and the fuel flow meter registered a 200-pound jump. A decision was made to abort the mission but as Captain Tyson turned toward his seat there was a loud explosion and the aircraft yawed violently and vibrated severely.

Tyson made it back to the pilot's seat. It took both pilots on the controls to maintain any semblance of a heading or attitude. An emergency was declared, stating that the aircraft was turning off airways and was in an uncontrollable descent, under IFR conditions.

Altitude was held at 4000 feet and a straight-in approach was authorized at a field where the weather was no problem. Ten degrees of flaps were lowered when 25 miles from the station and the vibration lessened considerably. However, the flaps had to be raised as 155 knots could not be maintained without increasing power. This was inadvisable as the No. 3 engine temperature was being kept within limits only by priming. A GCA run was made, gear and flaps were lowered on the final and a normal three engine landing made. By regaining control of the aircraft and by his fine technique, Captain Tyson safely landed 122 passengers and crew. Well Done!



# “Operation Standard”

Much time and effort is being expended by the USAF to make all cockpits STANDARD

THE setting was a small room in one of the many huge buildings that shadow the nation's capital. A panel was in session for the 33rd time. The atmosphere was quiet . . . and serious. Representatives of the USAF, Army, Navy and leading aircraft industries were there. They were talking about the aircrewman—his safety and comfort.

The subject of cockpit standardization has been kicked around many times when pilots have gathered to bat the breeze. It is often laughed at and more often cursed. The time has come, as the walrus said, for some clarification on the problems and progress of the standard cockpit.

During World War II the high rate of pilot error in aircraft accidents focussed attention on the problem of cockpit design. Although some research efforts were directed toward this problem during the war, cockpit design for maximum pilot efficiency and safety first received serious consideration early in 1946.

When the Cockpit Layout Subcommittee of the Aeronautical Board was established in 1946, one of the first items to be considered was the standardization of instrument panel layout. It was thought at the time that the easiest approach to the problem would be to poll a large number of pilots to obtain their ideas on just how the instruments should be arranged with relation to each other. Several hundred pilots answered these questionnaires. After examining quite a few of these, it was pretty obvious that the solution could not be obtained by this method, since there were almost as many variations of arrangements presented as there were pilots answering the questionnaires.

Next it was decided to evaluate the various instrument arrangements in military and commercial aircraft to discover if any one particular arrangement had been given precedence over all the others. This proved a complete waste of time also, since although there was some semblance of standardization evident in aircraft designed by the same manufacturer, there was little or no standardization between aircraft produced by different companies.

A lengthy program of experimentation, survey and testing has been under way ever since. A large number of results have been attained and more are on the way.

Typical of the early surveys was one on "Pilot Preference Regarding Knob Shapes to be Used in Coding Aircraft Controls," made in February 1947. Sixty pilots were presented with models of 11 knob shapes and asked to note on a questionnaire (1) any shape which they considered impractical and (2) which controls they would prefer to have coded and which knob shapes should be used on these controls.

In general, the pilots agreed on which controls were most in the need of shape coding and to some extent agreed as to which knob shapes should be on which control. However, disagreement on preferences has always been a problem for the people concerned with cockpit design. Thus, surveys have not always proved practical to determine the principles of standardization. But it is interesting to note that some of the shapes preferred by the pilots in this early survey are now standard for the cockpit.

### Experiments and Studies

Many valuable studies were completed in these formative years. In April of 1947 the Aero Med Lab completed one on "Direction of Movement in the Use of Control Knobs to Position Visual Indicators." Two separate experiments were undertaken. The first study was conducted to determine the preferred control response to deviations of simulated linear indicators in five common control indicator arrangements. The second study was conducted to determine the effect on speed and accuracy of reversing the motion relationship in two control indicator arrangements.

It was found that in the arrangement where the indicator and the control were in the same plane, with the indicator perpendicular to and centered about an extended radius of the knob, operators consistently responded as though they expected the indicator to move in the same direction as the portion of the control knob adjacent to the indicator. It was found that in two other arrangements where the indicator and control were not in the same plane, the operator's responses were inconsistent.

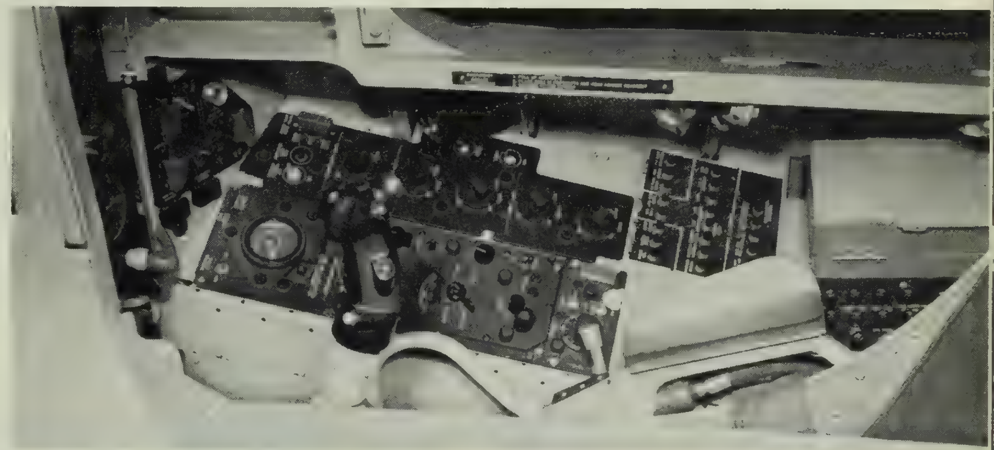
The effect of pointer alignment on check reading of engine instrument panels was studied and published in a Memorandum Report in 1948. Four experiments were conducted using a panel of 16 simulated aircraft engine instruments, $1\frac{3}{4}$ inches in diameter, mounted in a fixed link trainer fuselage. When the panel was exposed, individuals were required to check read the panel and take appropriate action by positioning one or more toggle switches. Six pointer alignment positions were examined, alignment at the cardinal 9, 12 and 3 o'clock positions, and mixed alignment about each of these positions. Two types of test situations were used. In one situation the subject merely indicated whether or not there was a deviation of any instrument. In the other situation each subject was required to identify any deviating instrument and the direction of deviation from a desired reading.

Conclusions drawn from the results of these experiments were as follows:

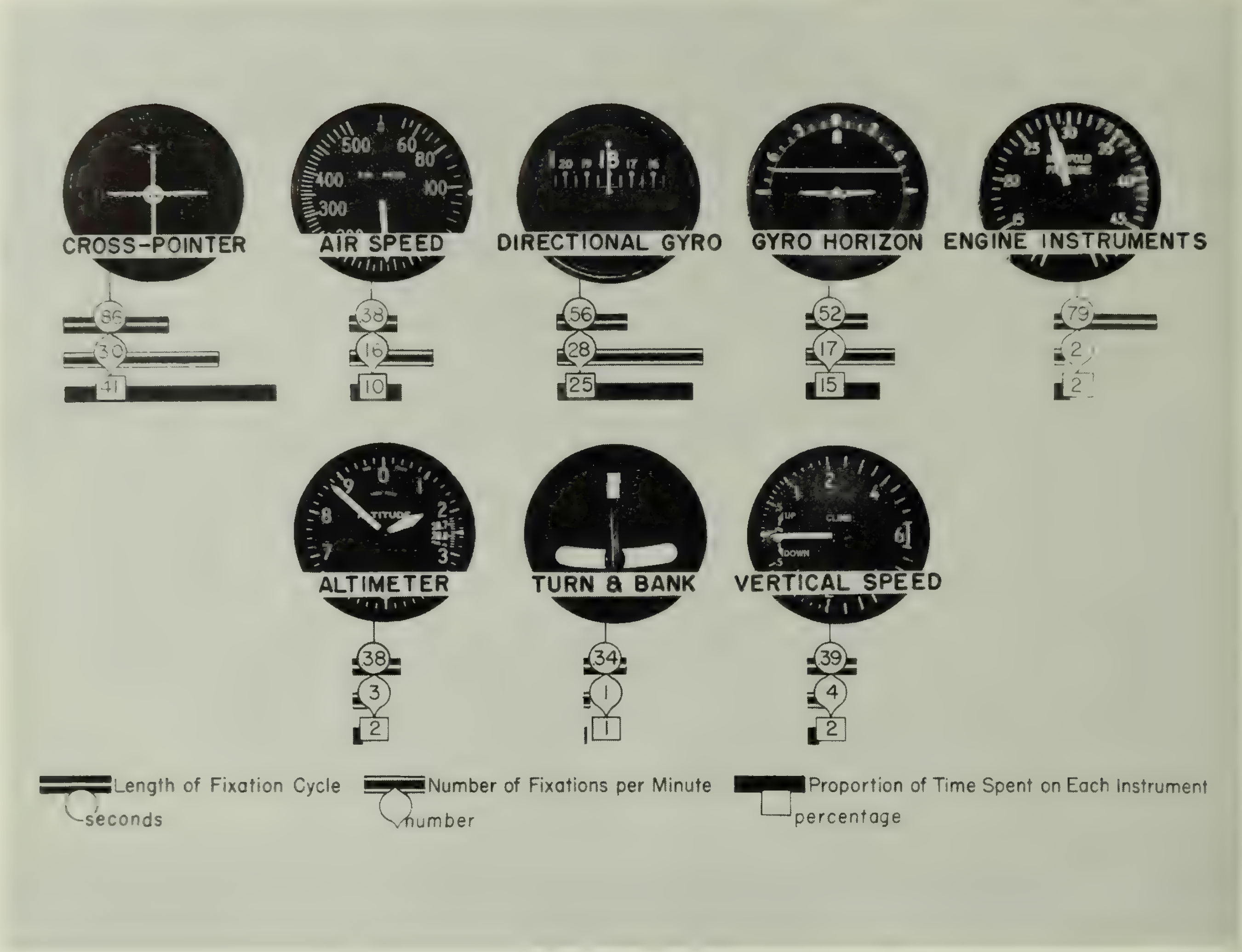
a. The rectangular arrangement of small engine instruments on multiengine aircraft will result in favorable speed and accuracy in check reading of engine instrument panels.

b. The use of rotatable instruments or rows of instruments, making possible uniform pointer alignment under any flight condition, will provide a significant advantage in speed and accuracy of check reading, although this advantage may be outweighed by the mechanical difficulties or other objectionable features of such adjustment provisions.

c. The judgment of the meaning of an instrument deviation will be more



On the page to the left is a photo of the instrument panel of the F-100. Note the simplicity and the standard location of the "basic six." Above and below are right and left consoles.



Length of eye fixations and number of fixations on aircraft instruments during ILAS approaches.

rapid and accurate with pointer alignment in the 9 or 12 o'clock position than in the 3 o'clock position. The experiment also showed that the 9 o'clock position is slightly superior to the 12 o'clock position.

In order to solve the instrument arrangement problem, a program of eye movement studies was initiated. The program consisted of a series of studies of pilots' eye movements while flying instruments under various conditions.

### Eye Movements

A typical example is the sixth of a series of investigations of eye movements of pilots during instrument flight which illustrates the manner of conducting these tests as well as their results. In this test the frequency, duration and sequence of eye fixations made by 15 pilots when flying day and night ILAS approaches with a new panel arrangement are summarized. For purposes of comparison, data previously obtained with the standard Air Force panel arrangement during ILAS approaches under day conditions are included. All conditions investigated showed that the cross-pointer, directional gyro, gyro horizon and airspeed indicator are the most used instruments.

Significantly, more fixations and shorter fixations were made for day approaches than for night approaches. The total number of fixations and the average length of all fixations were approximately the same for both the standard and new panel, although there were some significant differences between individual instruments. More experienced pilots tended to make slightly more and shorter fixations than less experienced pilots. From the standpoint of the distance between the most frequent eye fixations, the new panel appears to have a better arrangement of instruments for ILAS approaches than the standard panel.

These tests were accomplished by mounting a movie camera in a C-45. The camera recorded pictures of a small mirror which reflected the pilot's eyes. The movies were then developed and studied to determine which instruments were looked at, how frequently, for what length of time and so on. Various types of flight conditions were included in the studies under simulated conditions.

Eye movement studies were also conducted under contact takeoffs, night straight and level flights, night and day level turns, zero reader approaches, straight descents and climbing turns.

Equipment used to make eye movement studies: 1. Hood, 2. Mirror, 3. Stop Watch, 4. Camera.

The time and effort expended on these various studies and experiments have not been wasted. They gave the cockpit standardization people a great insight into not only what the pilot wants in the cockpit but also what he should have. In fact, one major problem is that the *wants* and the *needs* are often not the same. However, the people in charge of the program, many of whom are pilots, know what should be in the cockpit and the way it should be arranged.

### Instruments Markings

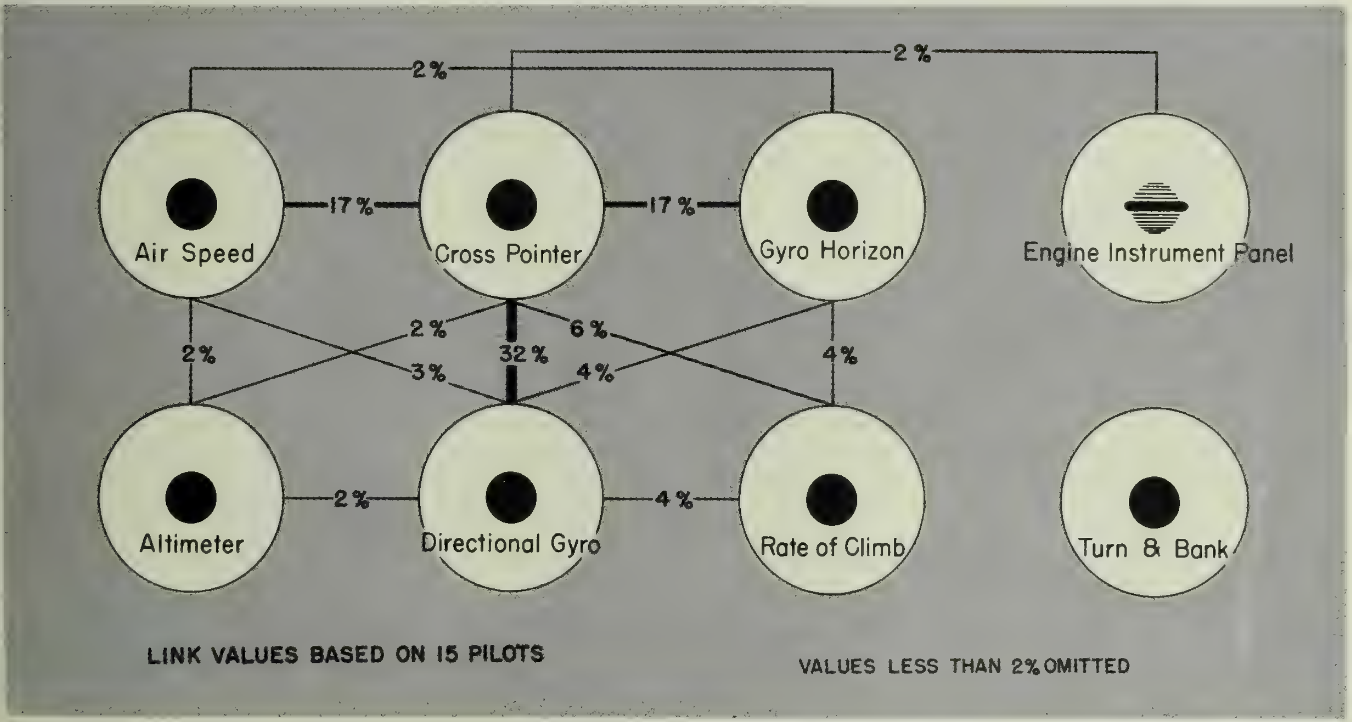
Information provided the pilot by his instruments, to be useful must first be visible. Markings must be of adequate size and properly lighted. However, the shortage of panel space limits the size of instruments and markings and the need for the pilot to see outside at night limits the permissible intensity of instrument illumination. Instrument reading time and errors are little affected until the brightness of the instrument markings falls to about .01 foot lamberts. On the other hand instrument reading performance deteriorates rapidly as the brightness falls below this value. Other data have been obtained in flight concerning the lighting intensity chosen by pilots for different reading requirements using three different lighting systems. For red flood lighting the pilots selected .003 foot lamberts as the minimum value for maintaining safe flight, and .02 as the normal value for adequate observation of the instruments while at the same time maintaining outside vision.

There are several different sizes of engine and flight instruments. For instance, the attitude and directional indicators are much larger than the conventional 3¼ inch airspeed indicator and other flight instruments. The fact that these instruments are larger and occupy a much greater volume of instrument panel space is recognized as a major problem of the aircraft designer. The large type attitude and directional indicators are required to adequately present small changes in attitude which can be immediately recognized by the pilot. They were developed as a result of pilots' complaints concerning their inability to obtain this information from the smaller dial face.

### Basic Instrument Types

A variety of factors have to be considered in order to present the information in the best form for the pilot's use. One of these is the basic

Eye movement links values between instruments during night ILAS approaches. Instruments were moved from grouping arrangement for test purposes.



| METHOD OF USE | MOVING POINTER | MOVING SCALE | COUNTER |
|---|---|---|---|
| 1. Quantitative Reading | Fair | Fair | Good<br>Minimum time and error in obtaining exact numerical value. |
| 2. Qualitative and Check Reading | Good<br>Location of pointer easily detected. Numbers, scale need not be read. Change in position easily detected. | Poor<br>Difficult to judge direction and magnitude of deviation without reading numbers and scale. | Poor<br>Must read numbers. No easily detected position changes. |
| 3. Setting | Good<br>Simple and direct relation of pointer motion to motion of setting knob. Pointer position change aids monitoring. | Fair<br>Somewhat ambiguous relation to motion of setting knob. No pointer position change to aid monitoring. Not readable during rapid setting. | Good<br>Most accurate monitoring of numerical setting. Relation to motion of setting knob less direct. Not readable during rapid setting. |
| 4. Tracking | Good<br>Pointer position readily monitored and controlled. Most simple relation to manual control motion. | Fair<br>No pointer position changes to aid monitoring. Somewhat ambiguous relation to control motion. Not readable during rapid changes. | Poor<br>No gross position changes to aid monitoring. Ambiguous relation to control motion. Not readable during rapid changes. |
| 5. Miscellaneous | Requires greatest exposed area, which must be illuminated. Scale length limited unless multiple pointers are used. | Saves panel space. Only small section of scale need be exposed and illuminated. Long scale possible by use of tape. | Most economical of space and illuminated area. Scale length limited only by number of counter drums. |

**Table of Recommended Indicators According to Use**

manner of indication. Conventional instruments used in aircraft to give quantitative information can be grouped into three general types: (1) moving pointer, fixed scale; (2) fixed pointer, moving scale, and (3) direct reading counter. Within these broad types there are many variations and subtypes including circular, curved and straight scales. Curved and straight scales may be mounted horizontally or vertically.

Uses to which an instrument can be put:

*Quantitative reading* — reading to an exact numerical value.

*Qualitative reading* — judging in a qualitative way the approximate value, the approximate deviation from a null or desired value and the direction from a null or desired value.

*Check reading* — verifying that a null or desired value is being properly indicated.

*Setting* — adjusting an indicator to a desired value, usually an exact numerical value, or adjusting it to match another indicator.

*Tracking* — intermittent or continuous adjustment of an instrument to maintain a null or desired value (compensatory tracking) or to follow a moving reference (pursuit tracking).

The above classification serves two purposes in that it provides a framework within which to carry out experiments on instrument design and that it assists the designer in the selection of the most suitable instrument for his purpose on the basis of research data. Table I illustrates some of the data available on the merits of the three basic types of instruments.

### To or From?

One of the most fundamental and frequently argued questions concerning control-instrument movement relationships centers around whether the moving element of the instrument should represent the aircraft or the earth. For example, on the gyro horizon should the moving element be a miniature airplane moving in relation to a fixed bar? This is referred to as "airplane reference" or "fly from." Or should the horizon bar move to simulate movements of the true horizon as seen through the windshield, as on the gyro in current use? This is referred to as "earth reference" or "fly to."

Among our present aircraft flight instruments most are of the airplane reference type. Exceptions are the conventional gyro horizon and cross pointer indicators. Many believe that an intermingling of the types of presentations in a cockpit adds much to the work load of the pilot.

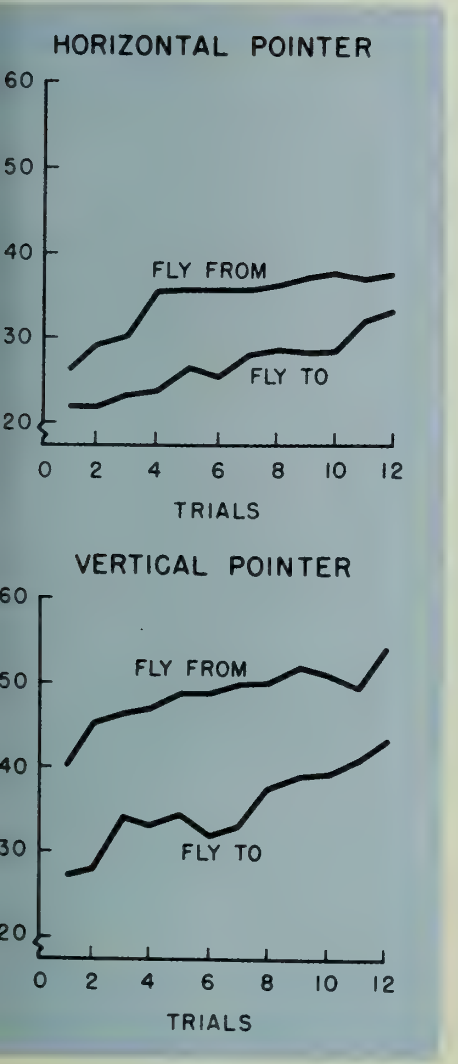
Also, all research directed toward determining which of the two types of presentation is superior has pointed to the "fly from" type. In spite of the consistency of the research datą on this question, pilots are still flying with gyro horizons and cross pointers using the "fly to" principle. However, to reverse the indicating principle on these two controls could be expected to confuse already trained pilots during the lengthy change-over period. For the gyro horizon there are additional difficulties of engineering, unless the instrument display is driven electrically from a remote gyro. This general problem is now receiving very serious attention and it is quite possible that further tests to be conducted in the near future will point the way to changes in these two instruments.

Engine instruments are used primarily for check and qualitative reading. Several years ago a new design and arrangement of engine instruments was developed to facilitate the type of reading required. This new system has been installed in all new multi-engine aircraft produced for the USAF of late.

In this system the instruments are arranged in columns for each engine and in rows for each function. At takeoff power the pointers are aligned horizontally at the 9 o'clock position. Should any pointer deviate from the horizontal line of pointers it can be detected readily as to engine and type of malfunction. Eight times as many instruments may be read in the same amount of time with this new system. Pilots and engineers on multi-engine aircraft have received this system very enthusiastically.

### The Basic Six

The basic six is a term by which standardization people refer to the gyro horizon, directional gyro, airspeed, altimeter, turn and bank and vertical speed instruments. (For aircraft equipped with ILAS, the turn and bank is replaced in the standard arrangement by the cross pointer.) Not only is this standard accepted by the USAF but by the Navy, U. S. airlines and the military aviation services of Great Britain and Canada, as well.



**Tracking performance shows a comparison of "Fly To" and "Fly From" presentation on cross pointer indicator for ILAS and zero reader. "Fly From" was preferred by 21 of 24 cadets.**

Of course, problems arise even for the basic six. Certain types of aircraft must be equipped with gunsights or, perhaps, scopes that must be placed in a given position which often conflicts with the standard arrangement. Compromises must be effected which accomplish the mission of the aircraft with as little deviation from the standard as possible.

Standardization of engine and navigational instruments has not progressed as far. The Air Force has published specific requirements for the location of engine instruments but in some cases the other services do not agree to these requirements. The USAF requires that navigational instruments be located functionally about the basic six. Again inter-service standardization has not been completed. It should be remembered, however, that even at this very moment studies and meetings are being conducted to meet this end.

### Standardization of Controls

There are three means which must be considered in the standardization of controls — design, location and method of actuation. Many cockpit controls have already been standardized in these three characteristics.

Take for example the landing gear and flap controls which, in older aircraft, were sometimes confused. Under the new system the gear control is shaped like a gear and the flap control like an airfoil section. The landing gear control is always forward of the throttle and the flap control aft of the throttle. This provides maximum economy of hand movement during takeoffs and landings. This standardized arrangement first began to appear in production aircraft in 1950. An examination of accident data has failed to uncover a single case of gear and flap confusion in aircraft having this arrangement.

Direction of control movement is also an important item in standardization. Gear and flap controls move in the same direction as the aircraft component to which they relate. Direction of movement principles have been specified which apply to all controls. For instance: all switches should move forward or upward, for ON; all knobs should rotate clockwise for increase; and a control (such as the throttle) should move forward for increase of aircraft performance.

### Warning Lights

One of the most controversial subjects of all is that of warning lights. The warning light must gain the pilot's attention quickly and stimulate him to emergency action. On the other hand, he must not become so alarmed that he cannot continue his normal flying activities. In spite of continuous efforts to limit the number of cockpit warning lights, the number has reached alarming proportions in some of the newest cockpits. One such cockpit contains about 80 warning lights in the pilot and copilot positions.

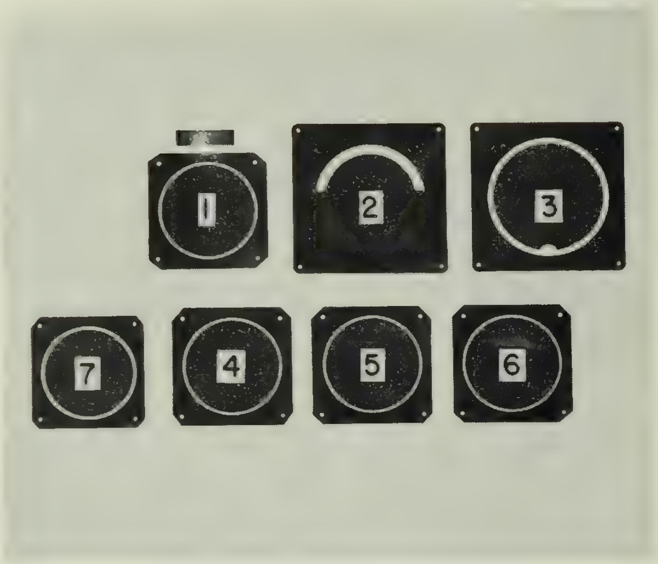
If the number of warning lights is too great the pilot has difficulty in identifying the particular malfunction. Warning lights which do not signify real emergencies will, until identified, be just as disturbing as critical lights. This serves to reduce the effectiveness of the important warnings. There is a wide variance of opinion among pilots on this subject. Some want a minimum of lights, others want not only many warning lights but also affirmative lights to show that nothing is wrong.

At the present time the standardization people are leaning toward a master warning light which will refer the pilot to a lighted panel. The panel will tell the pilot by lighted words what is wrong. The master warning may be turned off by the pilot after he sees on the panel what is wrong. When another emergency condition arises, he will be warned again. However, the light on the panel will stay on until the condition has been corrected. Also under consideration are the pop-up flag warnings and auditory warnings.

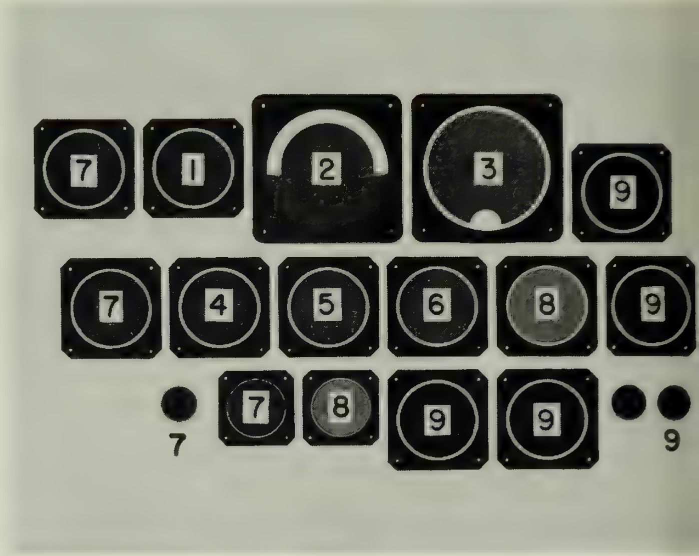
This subject is still in the experimental and study period. Here again, standardization will be difficult because of the great differences in aircraft and their functions.

### The Military Standard

In spite of all these accomplishments the aircrewman may still ask, "What does all this mean to me? I



Standard Basic Flight Group Arrangement.



Standard Instrument Arrangement — Jet Fighter.

am still not flying a standard cockpit." Inevitably, there is a delay between research and application of the results to the design of production equipment. For this reason it has only been in the last few years that applications of human engineering research and cockpit standardization have begun to appear in production USAF aircraft. Improvement in cockpit design and arrangement has been quite significant. Pilot transition from one type of aircraft to another has been vastly improved.

To check this the aircrewman has only to look at two documents that are the direct result of the efforts toward cockpit standardization. These are the Military Standards, which lays down the standard for location and actuation of cockpit controls, and the Handbook of Instruction for Aircraft Designers which sets down the requirements the builders and designers of aircraft must follow.

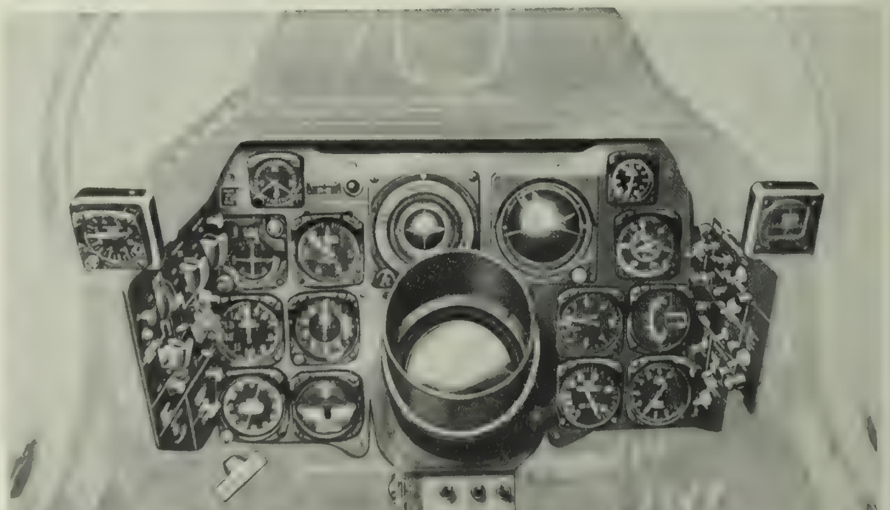
This document defines three types of cockpits: the single pilot, the tandem pilot and the side-by-side pilot. It goes into detail on where controls will be located as well as how they will be actuated. Shapes of control knobs and cockpit dimensional requirements are set down. Location and comments are established on all ground and flight controls from the check-off lists to the nose wheel steering control for all three types of cockpits. Power plant controls, fire fighting controls, electrical and radio controls, instrument panels, armament controls and miscellaneous controls and equipment are all broken down specifically. The assignment of all controls to crewmembers by classes is accomplished.

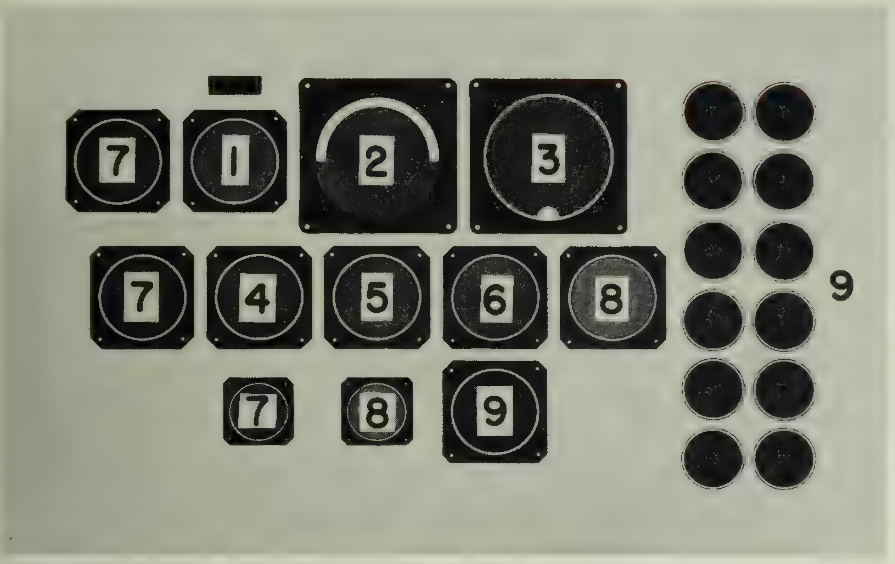
The Handbook of Instruction for Aircraft Designers (HIAD) serves for much the same purpose as the Military Standard except that it goes into greater detail. The criteria of this document were established for the development of standard functional aircrew stations with the intention of reducing to a minimum pilot error, pilot transition time, pilot fatigue and such other factors that impede the completion of a mission and are detrimental to flying safety. Chapter 6A.0 is devoted to the accommodation of all aircrew members with particular emphasis on the flight station or cockpit. Location and actuation of cockpit controls, instrument arrangement and lighting, and the dimensional requirements of the cockpit necessary for the accommodation of a large percentage of USAF pilots are among the items listed.

To illustrate the detail and thoroughness of this publication the following extraction was made as a typical example:

*b. Carburetor Air Control*
*The carburetor air control*

At times scopes must be placed in a given position which conflicts with standard arrangement.





**Standard Instrument Arrangement — Multi-engine Jet Aircraft.**

1. Airspeed Indicator
2. Directional Indicator
3. Attitude Indicator
4. Altimeter
5. Cross Pointer
6. Rate-of-Climb
7. Other Flight Instruments
8. Navigational Instruments
9. Engine Instruments

**Key to instruments in standard arrangements.**

*shall be located at the lower aft position of the power quadrant outboard and aft or below the oil cooler control.*

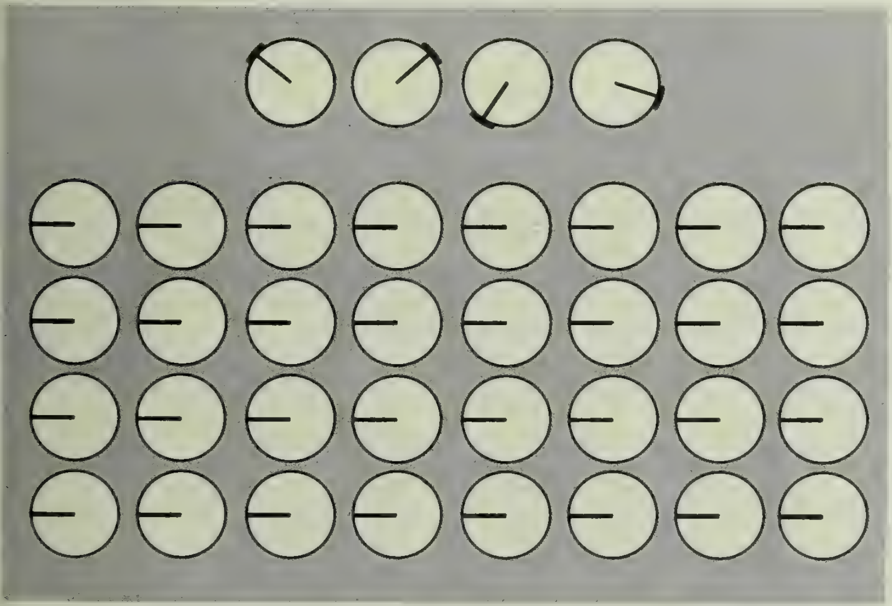
*The actuating motion for the carburetor air controls shall be forward or upward for RAM AIR, the middle position for FILTERED AIR and the aft or bottom position for HEATED AIR.*

*In the event a two position hot-cold switch is used, the actuation shall be up or forward for COLD and down or aft for HOT.*

*The shape of the carburetor air control knob shall comply with the configuration and dimensional requirements set forth in Drawing AD26.*

Designers for the aircraft corporation must follow these requirements. Before a new aircraft goes into production it is subject to minute scrutiny on mock-up boards by representatives of the cockpit standardization panels and the using activity. At times compromises must be worked out. These occur only when requirements are conflicting or cannot possibly be met. The matter is then referred to experts in that particular area of the USAF and the problem is worked out with as little deviation from the standard as possible.

**Instrument check reading time is decreased by pointer alignment in the 9 o'clock position.**



### Helicopter Standards

Much work and effort are being expended to standardize the helicopter. However, the instruments presently installed in the 'copter are inadequate. For the most part these instruments were designed primarily for fixed wing aircraft with flight characteristics radically different from normal helicopter flight. Specifically, improvement of attitude indicators with large pitch and dive displacements is badly needed.

Studies and experiments are under way to gather all pertinent data on the helicopter cockpit. An eye study similar to the one on fixed wing aircraft already mentioned, is being conducted and should prove invaluable. In the meantime, an HIAD section for rotary wing aircraft has been published with specific requirements broken down in detail.

The work on cockpit standardization is by no means completed. Giant strides have been made in the last few years and the view into the future is bright. As flight becomes more complicated by greater speeds and higher altitudes, it is vitally important that the cockpit is becoming standard and, thus, simpler.

Operational efficiency of aircraft should never exceed the efficiency of the crew. Standardized aircrew stations mean higher quality of flying and a reduced accident potential. ●

# Keep Current

NEWS AND VIEWS

**No Sweat for ARS** — Recently, radar again played the leading role in another successful rescue performance at Narsarssuak Air Base, Greenland. Situated at the head of the 45-mile-long Tunugdliarfik Fjord, Narsarssuak Air Base is one of the few fields in the world that has practically no instrument letdown procedure. Letdown to 1300 feet must be made at Simiutak, an island at the mouth of the winding fjord, and then it's a VFR approach all the way. If the fjord is closed and the ceiling at Narsarssuak is less than 7000 feet, there is no approved letdown. ADF is available for letdown to 4500 but can only be used if the pilot has specific orders authorizing such a letdown procedure.

In this instance, a DC-3 was inbound to Narsarssuak from Keflavik, Iceland. Approach Control advised Air Rescue that the aircraft had passed the point of no return and would continue on to Narsarssuak. The weather was steadily falling below minimums, and high winds were being forecast.

The DC-3 arrived at Simiutak, let down to 500 feet and started up the twisting fjord.

At Narsak village, visibility was completely obscured so the aircraft made a 180 and headed back for Simiutak. Weather reports from Simiutak, Narsarssuak and a weather station between, Narsak, were as follows: Narsarssuak had 500 feet obscured, with ¾ mile visibility and snow showers. Simiutak reported 1200 feet overcast, with five mile visibility in snow. Narsak reported total obscuration in heavy snow. Not only was the fjord impassable but the DC-3 reported only one hour of fuel remaining.

Shortly after the last contact with the distressed aircraft, an Air Rescue SA-16 took off to attempt interception. At this time the ceiling had raised to 1000 feet over Narsarssuak but the fjord was still closed.

The SA-16 plunged into the fjord and proceeded toward its rendezvous with the other aircraft. The ceiling descended lower and lower. Ten miles away from the base and at 100 feet, the ground could barely be seen -- forward visibility was ⅛ mile. Radar steers had to be used to guide the aircraft through the next 20 miles of the closed fjord and narrow passes.

Breaking into the clear in the lower part of the fjord, with a ceiling of 500 feet, an immediate visual intercept was made with the distressed DC-3. Radio contact had been established previously on an emergency frequency while the SA-16 was on its radar run. Upon interception, a 180 was made and as the distressed aircraft tacked on to the SA-16, the run back up the fjord was started.

The Rescue aircraft, with the DC-3 in trail, descended to 100 feet. As the first radar run started, an immediate breakaway became necessary to avoid low island hills that loomed up through the storm. Contact was again made and another radar run started. The hazardous trip through the narrow defile was again accomplished, although at times visibility was so poor that the DC-3 almost lost sight of the Rescue aircraft. A few miles from Narsarssuak, where the fjord widens, the ceiling lifted and visibility improved considerably.

At this point the fuel supply problem had become somewhat acute. However, supplied with precise information as to runway heading, distance to the base and other essential details for a straight-in approach, the DC-3 made a safe landing.

One of the DC-3 crew stated:

"All words are inadequate in describing one's feelings concerning the job being done by the Air Rescue Service. Only after having personally gone through the experience of being bottled up in the iceberg-ridden fjords of Greenland, can one begin to realize the slim chances of survival without them and their radar equipped aircraft to lead you in. There is no more overwhelming feeling than when you sight them coming to your aid, and to know your troubles are almost over. It is a very comforting thought to know these men are on the spot to assist any and all aircraft in trouble in this treacherous area."

★ ★ ★

**New Jet Tanker-Transport** — Boeing Airplane Company's new prototype jet tanker-transport was unveiled in May. Primarily, the huge aircraft was built as a multi-purpose fuel tanker-troop transport for the armed forces. It is designed to increase the range, striking power and mobility of the Air Force's present and future jet air fleets.

Multi-purpose fuel tanker-troop transport is designed to increase USAF range, striking power.

With a cruising speed in the 550 mph class, bettering by some 100 mph the fastest jet transport yet built, the new plane will be capable of transcontinental non-stop flights in less than five hours, and non-stop New York-to-London flights in less than seven hours. It will be capable of carrying over 100 passengers and will cruise between 30,000 and 40,000 feet.

The prototype's swept-back wings have a span of 130 feet; with a length of 128 feet, tail height of 38 feet and a gross weight of 190,000 pounds. It is powered by four Pratt & Whitney JT3-L engines, each rated in the 10,000 pounds of thrust class, mounted individually in pods.

★ ★ ★

**Special Notice to Airmen** — Effective July 1, 1954, ATC will no longer use the term "nonstandard pattern" when issuing holding instructions to IFR flights. The standard elliptical holding pattern, as described in the Flight Information Manual, is made up of right-turns and is two minutes long. Any holding pattern becomes a nonstandard pattern if either or both of these two components are different. Clearences for holding in nonstandard patterns will contain a brief description of the nonstandard features of the pattern. Absence of instructions regarding the direction of turns will mean that right-turns should be flown. Absence of instructions regarding the length of the pattern will mean that a two-minute pattern should be flown.

A clearance for holding in a right-turn, one-minute pattern will only contain the length of pattern, i.e., "ONE-MINUTE PATTERN."

A clearance for holding in a left-turn, two-minute pattern will only contain the direction of turns, i.e., "LEFT-TURNS."

A clearance for holding in a left-turn, one-minute pattern will contain both the direction of turns and length of pattern, i.e., "LEFT-TURNS, ONE-MINUTE PATTERN."

An innovation on B-47E is the stinger tail.

★ ★ ★

**B-47E Takeoff Assists** — New B-47Es now being delivered to SAC are provided with an increase in available takeoff power through a new external rocket arrangement and a water injection system in the six engines. The B-47E has a maximum gross weight of 200,000 pounds, 15,000 pounds more than earlier models.

The water injection process consists of spraying a mixture of water and alcohol into the combustion chambers of the J-47 engines to increase the mass flow through the engines and the velocity of the jet gases.

Also, a new collar-type rack, mounted beneath the fuselage, has positions for 33 ATO units of 1000 pounds thrust apiece. This new rack, which has 15 more positions than any previous arrangement, can be dropped from the plane after the power has been expended. This arrangement means that additional equipment can be carried in the compartments which formerly contained the internal ATO units.

The additional power means that the B-47E can be operated from shorter fields and can lift maximum loads from existing runways. Using both water injection and ATO, today's production models can cut many feet off an ordinary takeoff run, depending on atmospheric conditions. However, Boeing engineers have pointed out that only under extreme conditions would both the systems be used simultaneously. Takeoff with a normal load calls for neither system but the value of their availability is obvious. If needed, the added power is there at the flick of a switch.

Another innovation of the B-47E features a new stinger tail. This remotely controlled tail turret system is capable of knocking down enemy interceptors at night or in cloud cover. Guided by radar, the turret was especially adapted for high-speed jet aircraft operation. The gun firing system is designed so that radar and an electric brain do most of the firing.

Water injection, 33 ATO units enable B-47E to use shorter fields with maximum loads.

The radar is switched on to "search" in danger areas to maintain a watch to the rear. When the radar picks up an attacking plane, a pip shows on the screen. Once the target is centered in the crosshairs it is tracked automatically. The tracking action supplies the system's computer with the necessary information, and when the attacking plane gets within range the guns are fired.

The system consists essentially of a tail turret mounting twin 20 mm. cannon, a computer, control equipment and search-track radar.

# BEST TEST

**A simple preflight check of demand oxygen regulators for outward leakage that should be SOP for every pilot and crewmember.**

ALL demand and pressure type regulators are designed around the principle of a demand diaphragm for controlling the flow of oxygen and a diluter valve for diluting the oxygen with atmospheric air to provide the required ratio of air and oxygen to the user.

The demand diaphragm operates the demand valve and controls the flow of oxygen according to the amount of suction created in the regulator by the user.

The diluter valve controls the flow of air into the regulator, decreasing the flow with increasing altitude so that the suction in the regulator creates a greater load on the demand diaphragm, thus giving more oxygen.

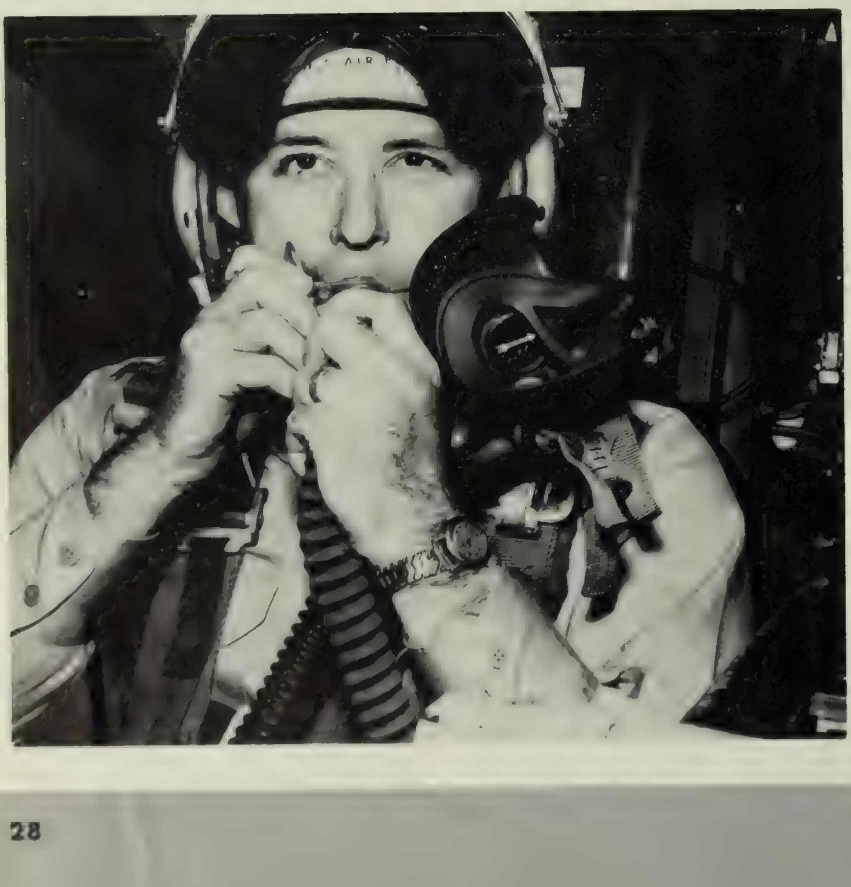
Possibly you know all of this. However, a brief recap of this critical subject can never be amiss.

A damaged diaphragm will allow excess air to enter the regulator during inhalation thus decreasing the oxygen-to-air ratio. In fact a diaphragm having a large hole in it may prevent any oxygen from being delivered to the crewmember.

On a pressure demand oxygen regulator, a damaged diaphragm or faulty diluter air valve will allow oxygen to leak out the regulator during positive pressure breathing.

From the above, it can be seen that the condition of the demand diaphragm and diluter air valve of oxygen demand regulators is important to insure proper operation of the regulator for the user.

Before takeoff each crewman should check regulator for outward leakage by blow-back test.



Before takeoff on each flight, each crewmember should check the regulator for outward leakage by a blow back test. This check cannot be accomplished while wearing a mask but must be done by blowing into the end of the oxygen regulator hose.

If there is resistance to blowing, it indicates that the demand diaphragm and diluter air valve are satisfactory. Little or no resistance to blowing indicates a faulty demand diaphragm or diluter air valve.

During the blow back test, do not throw yourself into the act with reckless abandon. If you overdo this blowing test, a pressure relief valve in the regulator opens, thus giving the impression of a bad leak. It is also possible for too much air pressure to temporarily seat a leaky diluter valve. Need we say more?

The blow back test with the diluter valve in NORMAL OXYGEN position will check the demand diaphragm and the diluter air valve on most regulators in service today. However, on a few types of regulators, including *all* A-14s, the blow back test with the diluter valve in NORMAL OXYGEN position will only check the diluter air valve. This is because at sea level the demand chamber is separated from the air chamber to supply normal atmospheric air to the user as there is sufficient oxygen in the air without adding oxygen.

Therefore, to check the demand diaphragm on many types, the blow back test must be conducted also with the diluter valve set in the 100% OXYGEN position.

At this point you may be somewhat confused and rather than print a long list of the various types now in service, let this be your guide. Regardless of the type, make two blow back tests. First on NORMAL OXYGEN and then on 100% OXYGEN. Make all of your tests by blowing gently into the regulator hose as during normal exhalation. If there is little or no resistance to this gentle blow back pressure, the regulator or the regulator hose is faulty.

The foregoing information was supplied by the Aero Medical Laboratory, Directorate of Research at Wright-Patterson AFB. We believe that such information is worth passing on to the field even though it may be old hat to some of you. This business of carelessness with personal equipment, and failure to make adequate precautionary checks is reflected too often on our statistical charts.

Again we say, *read* and *heed.* ●

# Don't Strafe On This Pass!

Any Air Force type that picks up a target like this in his gunsight or even on a radar screen is very likely to be a little shook up about the whole caper. We are happy to state that at the June Gunnery Meet at Nellis AFB, the targets were all GI, consequently no one was carried away by target fixation as well might have occurred if the passes had been made on this little doll.

In fact, congratulations are in order for all those who participated in the accident-free meet. See our picture spread on pages 14 and 15.

# Mal Function

Mal attends the Gunnery Meet
Claims that he cannot be beat

Sensible Commander has read of Mal
Plays it cool and grounds our pal.

In August issue, if luck holds good
We'll brief the Meet the way we should.

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AUGUST 1954

# FLYING SAFETY

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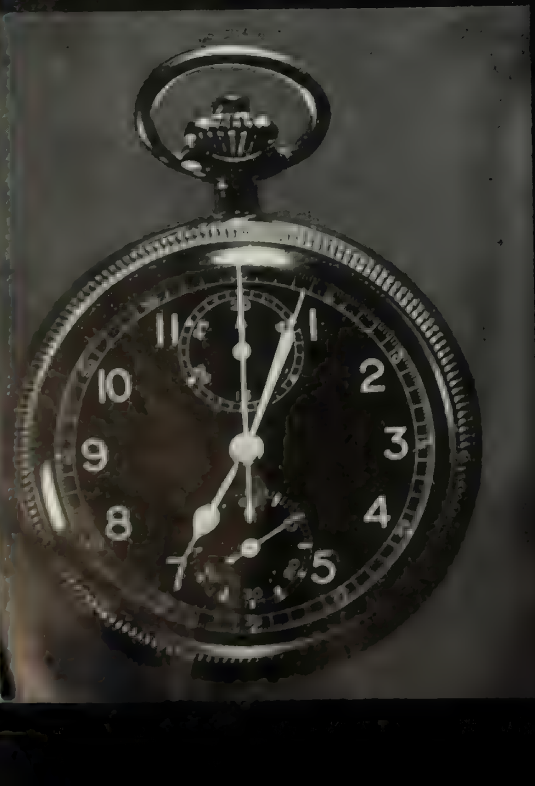
Seconds eat up space. See story on page 16.



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# CROSS FEED

LETTERS TO THE EDITOR

### Covered Visor

I'd like to mention what I consider a potentially dangerous occurrence which could happen if, prior to takeoff, a pilot failed to remove the protective cover from the visor of the flying helmet. Recently I overheard this being discussed by two pilots. The pilot (talking) was number two man in a formation of F-86s, and just after takeoff, a turn was made to the left, into the sun. This pilot pulled his visor down and with the cover on he could not see. Fortunately, this time there was no collision.

It is suggested that Flying Safety Officers discuss this with pilots at their meetings. The protective cover part number is 51C3808 and the visor part number is 81C3632. Also, you might mention it in *Flying Safety Magazine.*

In closing, I'd like to say that your very informative magazine is thoroughly read and enjoyed here by both air and ground crew personnel.

**T/Sgt Harry M. Ferguson**
**Instr. 108th M&S Gp (ANG)**
**Newark Airport, N. J.**

*The Sergeant has a point. Check those visors before leaping off.*

★ ★ ★

### Fit To Fly

I would like to thank Colonel Moseley for his well presented article on "Fit to Fly," in your May issue of FLYING SAFETY.

How many times have we heard people in our organizations say, "Oh, I'm not sick enough to go on sick call," or "The old man would think I was just goofing off," or even "I just have too much to do this morning to worry with a cold."?

I am a control tower technician for Airways and Air Communications Service and must take a yearly physical examination like the officers and airmen on flying status. It is a risky business to put a sick tower operator on duty with the great responsibility he has, being the eyes and ears of an air base.

It is my firm belief that tower operators, GCA operators, ARTC personnel and all officers and airmen who work directly with various phases of flying should use good common sense at all times and not doctor themselves, but should let the Flight Surgeon decide.

**T/Sgt Donald E. Bradford**
**1944-7 AACS Det, APO 65**

★ ★ ★

### More Safety Records

The First Tactical Reconnaissance Squadron, flying RB-26s, completed 15,000 accident-free flying hours on 21 June 54. The last accident was on 1 May 1951 when a nosewheel collapsed because of materiel failure. The 12th Air Force believes this to be a record for this type aircraft flying similar missions.

**10th Tactical Recon Wing**
**Spangdahlem AB, Germany**

●

At the close of June, the 318th Fighter-Interceptor Squadron completed a year of successful operation at Thule Air Base. The squadron, commanded by Major W. O. Belton, and operating F-94B all-weather interceptors and T-33 instrument trainers, accomplished 7 313 hours of flying training. This outfit averaged over 40 hours per month per aircraft, and its aircraft were maintained in commission at a rate of 84.8 per cent.

A single hard landing marred an otherwise perfect flying safety record for the squadron several months ago. Since that time, nine consecutive months of accident-free flying was accomplished, part of which was during the winter period of continuous darkness and sub-zero temperatures.

A yearly aircraft accident rate of 13.7 was achieved by this squadron.

Invaluable experience for the 318th's air crews and maintenance personnel has been derived from the training accomplished during the past year at this Arctic outpost.

**PIO, 318th F-I Sq**
**Thule AB, Greenland**

*FLYING SAFETY would like to hear more from the field about outstanding safety records.*

★ ★ ★

### File Prunes Under "P"

Early in January your office advised us that our Library's allotment of FLYING SAFETY would be increased by 20 additional copies each month, starting with the January issue. Up to now, we have not received any of the copies promised, and, moreover, the two copies that we had originally been getting each month were not sent after February. We did receive two copies of the February issue.

You will be interested to know that about ten days ago we did receive from you a one-pound, 14-ounce box of pitted prunes (packaged by the Al Pearce Orchards of California).

Would you kindly check to determine if we have been placed on the mailing list for the additional copies of FLYING SAFETY and if the extra copies for the past three months are to be sent?

Also, what disposition is to be made of the prunes?

**Marion Gaffney**
**Periodicals & Documents Section**
**National War College Library**
**Washington, D. C.**

*Our Circulation Manager advises us from Lower Slobovia that you should eat 'em, gal.*

# Panel White on Left Site

**Here's how the Tigers do it. Gunnery patterns and training SOPs explained by Nellis AFB instructors.**

THE RANGES were set up, the air-to-ground targets were clear, the tow targets were ready and team personnel were eager at the crack of dawn on 7 June, the start of the first all-jet U. S. Air Force Fighter Gunnery and Weapons Meet.

Brig. Gen. J. E. Roberts, Commander, Nellis AFB, fittingly summarized the purpose of the meet when he stated, "The first all-jet U. S. Air Force Fighter Gunnery and Weapons Meet is an important occasion, both for the American public and the Air Force, for this meet enables the Air Force to evaluate the combat readiness of competing pilots and support personnel. Tactics and continuing training requirements for an ever-ready and mobile, world-wide Air Force can be determined.

"Some of the U. S. Air Force's best pilots and equipment will take part in the six-day meet. It is friendly but hard fought competition between far-distant Air Force commands: but more than that, it is a forum for flying and maintenance techniques. Korea veterans will demonstrate the battle abilities which gained complete mastery of the air for the United Nations over the Communist forces in North Korea, while pilots and other personnel not battle-tested in Korea will learn much from those who fought the Reds."

The importance of the meet was highlighted by the important observers from U. S. military services and NATO countries and by the many officials from the aviation industry who attended.

Months of planning by the project officer, Lt. Col. Franklin L. Fisher, and his staff went into preparing for the meet before the 12 teams representing eight USAF major commands arrived. Housing and transportation had to be arranged. A 100-man team of judges had to be assembled. Meet rules had to be set up and agreed upon. Materiel and reserve supplies had to be procured and stocked to allow for any eventuality. And a complete book of SOPs had to be written, covering every phase of the meet.

One of the prime targets in this jet "World Series" was to see that it was accident-free, just as the 1950 meet was. Credit for "hitting this target right in the bull" goes to all participants, from the supervisory personnel and judges, the team pilots and ground support people to the behind-the-lines men who performed every chore from scoring to opening and closing the ranges.

The meet "book" which was issued all team pilots was another important item in establishing the accident-free record. It was of invaluable assistance in briefing the competitors in all procedures to be used while at Nellis.

The SOPs included a policy whereby all competitors were to report all incidents and near-accidents to the Wing FSO who could then take action where necessary to rectify the situation. Location and use of the crash barrier were explained fully. Pilots were briefed on the possibility of crash landings and given maps of local areas depicting dry lakes where forced landings were feasible. Experts explained the use of parachutes in the rough terrain, emphasizing how to land and what to do after landing in mountain country. Survival technique was discussed; all pilots were required to carry survival equipment, including a signal mirror and whistle, and to wear suitable foot gear.

Briefing on emergency procedures included whom to call if an emergency occurred, how to give a position report by using local grid maps, duties of wingmen in the event a team member was forced down, how to proceed after a landing was made (either in the aircraft or by chute) and procedures used by the helicopter rescue teams.

Qualified Nellis AFB instructor pilots served as tower and mobile control officers during the entire meet. Their duties included coordinating all takeoffs and landings, checking gear and flaps down on landings, assuring adherence to the traffic pattern (pilots were briefed on letdowns and patterns for all Nellis runways), assisting pilots having difficulties in landing, helping during possible emergencies and insuring that aircraft returning with less than 100 gallons of fuel made closed patterns.

The "book" also specified tow target aircraft procedures and designated runways for hung targets and cables, spelled out traffic spacing distances and pinpointed rendezvous points on the gunnery ranges.

Pilots assigned firepower and precision flying demonstrations were fully briefed with emphasis on minimum altitudes, general area peculiarities and range procedures.

Besides the usual means of determining fouls on the gunnery ranges, a special radar device was developed to check pull-out altitudes in the air-to-ground phase. The equipment was developed by a General Electric Company representative in conjunction with Nellis range officers. It was designed to replace the existing angleometer system in order to warn pilots immediately when they entered the danger zone.

An APG-30 airborne radar unit, normally used in the gunsight system, with an antenna installed in a separate rig, permitted vertical and horizontal aiming of the signal cone to cover rocket, bomb or strafing targets. Radar circuits were fed into an oscilloscope to give visual indications of planes entering the field of control.

Center line of the signal cone was zeroed-in to the center of the target. Elevation of the signal area was set to desired minimum altitude, 500 feet for rocketry, 35 feet for skip bombing and 1000 feet for dive bombing—during the meet. When a pilot passed below the set minimum, the scope operator spotted the error and flashed a report to range control and the pilot was notified immediately. The equipment's reliability enabled accurate measurements to be made within tolerances of plus or minus 25 feet.

Four teams from four major commands competed in the Special Delivery phase: 20th Fighter-Bomber Wing, USAFE; 3600th Flying Training Wing, Air Training Command; 49th Fighter-Bomber Wing, FEAF, 31st Strategic Fighter Wing, SAC.

Eight teams from eight major commands competed in the Day Fighter phase of the gunnery meet; 3595th Flying Training Wing, Air Training Command; 146th Fighter-Bomber Group, ANG; 508th Strategic Fighter Wing, SAC; 64th Fighter-Interceptor Wing, AAC; 64th Air Division, NEAC; 8th Fighter-Bomber Wing, FEAF; 86th Fighter-Bomber Wing, USAFE, and the 366th Fighter-Bomber Wing, TAC.

Each team flew six air-to-air missions; two were free-style at 20,000 feet; two radar at 20,000 feet, and one free-style and one radar at 27,000 feet. Each aircraft carried 400 rounds of .50 caliber ammunition, with each pilot allowed a maximum of six passes at the tow target. For the meet, minimum angle-off allowed was 15 degrees and minimum range 600 feet. Scoring was based on 100 per cent with each round of ammo counting as one-quarter of a point.

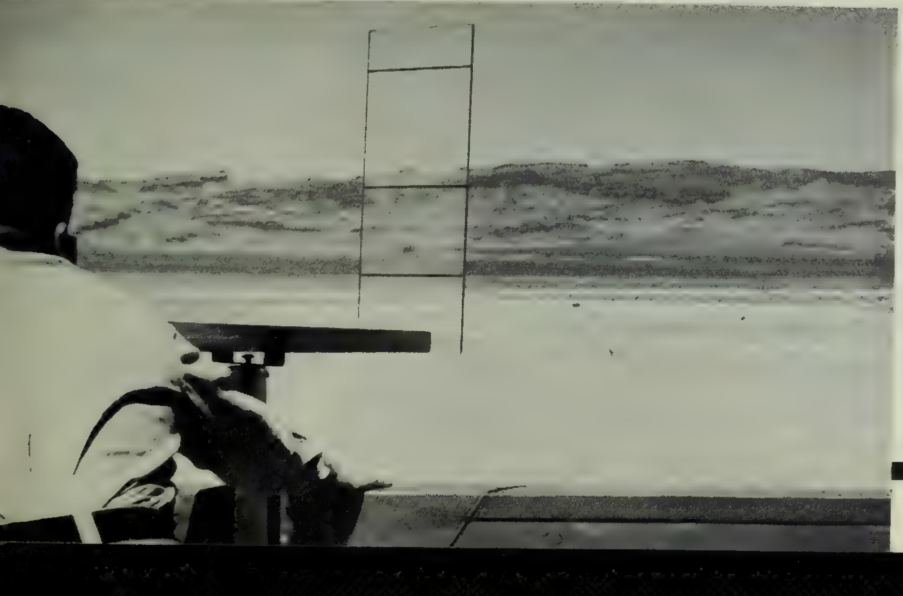
Each team flew two low-angle bomb/low-angle strafe missions during the meet. Each aircraft carried four 3-pound practice bombs per mission and 400 rounds of ammunition. Each pilot was allowed five passes to release his four bombs, and for the strafing phase each pilot was allowed six passes.

Two high-angle bomb/rocket missions were flown by the eight teams. Each aircraft carried four 3-pound practice bombs and four 2.25-inch rockets. The target was a circular grid area on the ground, with an old auto body serving as the bullseye. Five passes were allowed to drop the bombs and five passes for the rocket runs. The best three out of four rocket hits were scored on a footage basis.

*Flying Safety Magazine* obtained the complete gunnery patterns and procedures, as used by highly qualified Nellis AFB instructor pilots in student teaching, which contributed

**Minimum low-angle strafing altitude is 150'.**

**Minimum altitudes were adhered to closely on air-to-ground missions. Two fouls scored zero.**



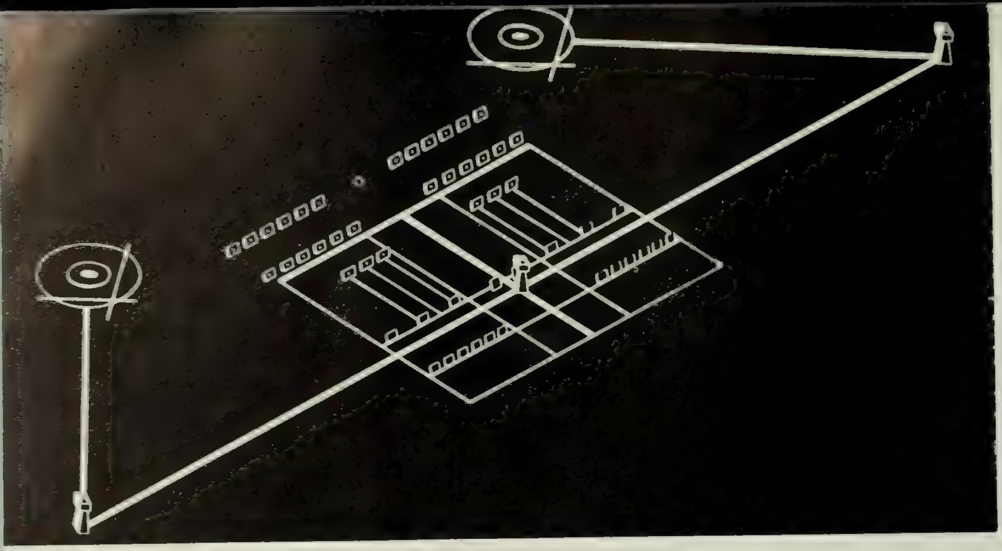


Fig. 1. Air-to-ground patterns are set up to preclude pulling guns through central tower.

Range officer checks on pull-out altitude.

to making this meet accident-free. We believe other organizations in the field can benefit from an account of these patterns and how they are flown. This article is concerned with procedures and general gunnery patterns. It is not intended as instruction in the finer phases of gunnery. No discussion is made concerning types of sights, wind drift, varying speeds for different aircraft, sight errors or depression angle corrections. It is intended to point out techniques which, if used, can help eliminate potential costly errors in procedure.

Each range is divided into two sites, left hand and right hand. A central observation and scoring tower dominates the range, with two sighting towers on the outside of each site. (See Fig. 1.) There are six 10′ x 10′ targets for strafing (two spares) on each site and four 10′ x 20′ targets for skip bombing. Two 150-foot bombing circles are used for the high-angle bombing and rocket firing.

All ranges are under strict radio control of the range officer, a qualified instructor, who is assisted by three spotters (one for each tower) and a recorder. Either the range officer or the flight leader can correct anything that appears incorrect in the pattern. This has been found to be a better all-around check on the flight, as the flight leader can't observe his number two man well in the pattern.

### Low-Angle Bombing-Strafing

Aircraft enter area in echelon, pilots check in by radio with the range officer and are instructed which site to use. Right hand traffic is flown on the left site, and left hand traffic is flown on the right site. This arrangement is used to keep pilots from dragging aircraft guns through the central tower area where personnel are stationed.

The flight leader then initiates a spacing pass, with each pilot breaking at three-second intervals. A properly spaced pattern will have one man turning off target, one man turning on target, one man turning on base leg and one man turning on downwind leg, simultaneously. The base leg must be kept constant to maintain proper dive angle. If adjustment of spacing is necessary, it should be made on the downwind leg by moving in or out to respace.

While making the spacing pass, the flight leader should achieve and hold release condition airspeed. This will enable the rest of the flight to trim their aircraft for release condition and to keep them that way around the rest of the pattern. While this method makes pattern control pressures greater, it gives better hits by insuring that the aircraft are trimmed properly at release. It will also prevent a pilot from using forward trim while at minimum altitude, and averts the possibility of runaway nose-down trim condition.

Airspeed in the pattern is contingent upon moderate power settings, on the sight settings, model of the aircraft being flown and conditions at the moment of release, firing or skip bombing.

Downwind and base legs are flown at 2500 feet above the terrain. The attack is initiated by making a steep, nose-low turn of approximately 45 to 60 degrees when the target is approximately 30 degrees, or at the one o'clock position. This will prevent the pilot from making too steep a peel-off on target. The aircraft will start to lose altitude as it rolls off base. The pilot should be lined up on the target, with wings level, at least 300 feet above the ground. He picks up his target (1, 2, 3 or 4) through the canopy (not through the sight), and then reduces altitude gradually down to 35 feet above the ground, maintaining the line-up with the target.

## THE WINNERS

### U. S. Air Force All-Jet Gunnery and Weapons Meet

**DAY FIGHTER PHASE**

*OVERALL TEAM (VANDENBERG TROPHY)*
1st — 3595th Flying Training Wing, ATRC
*AIR-TO-AIR TEAM*
1st — 3595th Flying Training Wing, ATRC
*AIR-TO-GROUND TEAM*
1st — 508th Strategic Fighter Wing, SAC
*OVERALL INDIVIDUAL*
1st — Captain C. C. Carr, ATRC
*AIR-TO-AIR INDIVIDUAL*
1st — Major W. H. Wescott, ATRC
*AIR-TO-GROUND INDIVDUAL*
1st — 1st Lt. R. D. Williams, SAC
*HIGH ANGLE INDIVIDUAL*
1st — Captain C. O. Chennault, TAC
*LOW ANGLE INDIVIDUAL*
1st — Major R. R. Wright, ANG
*HIGH TEAM CAPTAIN*
Colonel G. L. Jones, ATRC

**SPECIAL DELIVERY PHASE**

*OVERALL TEAM (McGUIRE TROPHY)*
1st — USAFE
*LABS HIGH INDIVIDUAL*
Major J. J. Kropenick, USAFE
*LABS LOW INDIVIDUAL*
1st Lt. N. L. Walters, FEAF
*DIVE BOMBING*
Major J. J. Kropenick, USAFE
*HIGH TEAM CAPTAIN*
Colonel J. A. Dunning, USAFE

**Too low—too slow—too flat on skip-bomb run.**

For best results 35 feet must be held; any lower will mean the pilot fouls on his pass while higher can mean incorrect sighting. A pilot should line his aircraft up with the target originally, then maintain the track with the gunsight until the release point.

After releasing the bomb, either the 100-pound or the three-pound practice bomb, initiate pull-up with wings level until the nose is 30 or 40 degrees above the horizon before starting the turn. It is at this point that a student may get in trouble if he starts his turn before bringing the nose above the horizon, particularly if the terrain is uneven and he is just a little too low.

The turn is then steepened, and the plane is rolled out on the downwind leg, again 2500 feet above the terrain, finishing a continuous 180-degree turn that gives the break-off end of the pattern an oblong shape. At this point the pilot should pick up the aircraft ahead to get and maintain proper spacing. Sights are turned on after leaving the home field, but gun switches, circuit breakers and bomb switches are not turned on until after entering downwind leg from spacing pass. On each pass, starting with the initial pass, each pilot calls in to the range officer the range (that is, left or right) and the color of the panel (red or white), which shows whether the range is open or closed.

For example, the flight leader might call, "Reno leader in, left and white."

After the last pass each pilot makes a radio check with the flight leader stating that armament switches are off, the sights caged and the circuit breakers pulled.

On a low-angle bombing mission a foul is committed if the aircraft gets

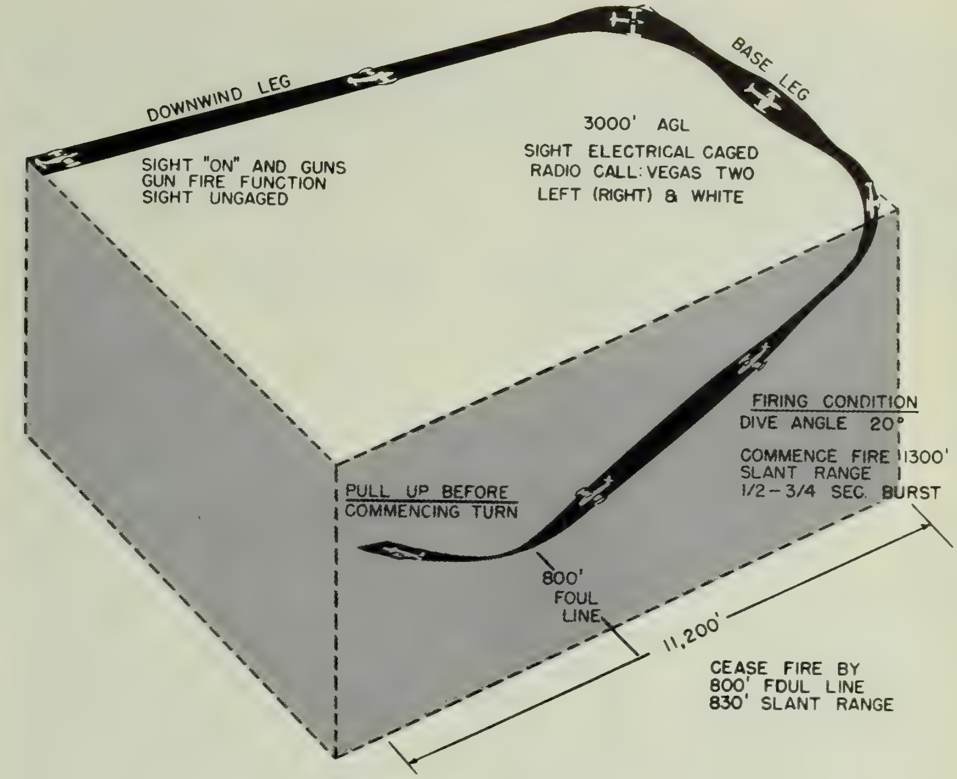
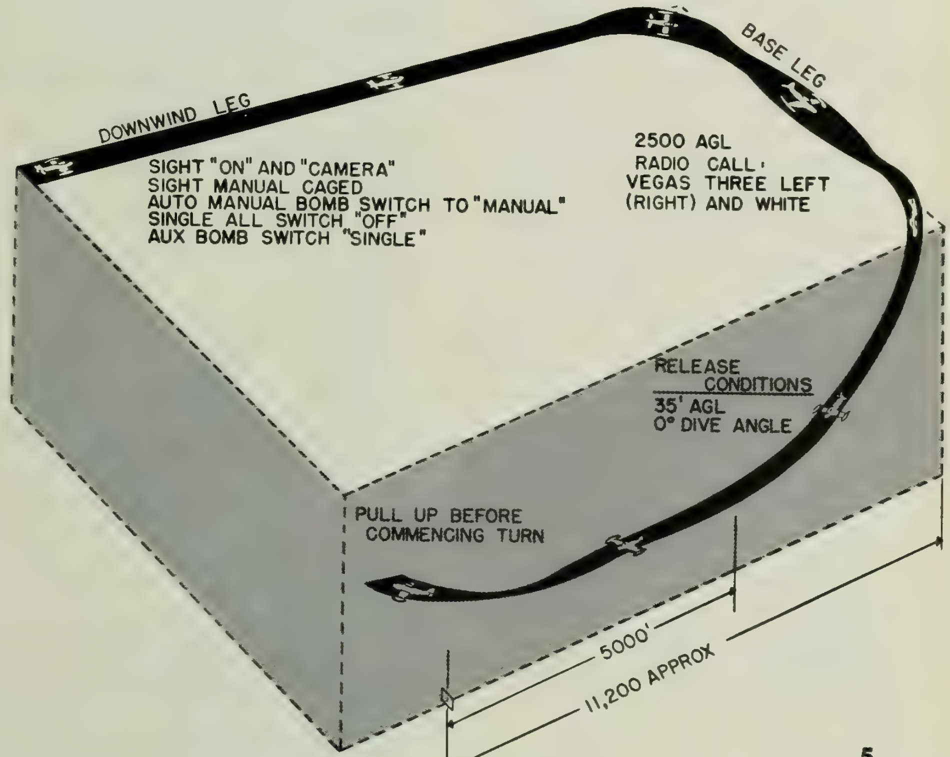


**Fig. 2. This Low-Angle Strafing pattern shows degree of dive and minimums used by all aircraft.**

**Fig. 3. Airspeeds vary but this Low-Angle Bombing pattern is standard for all jet fighters.**



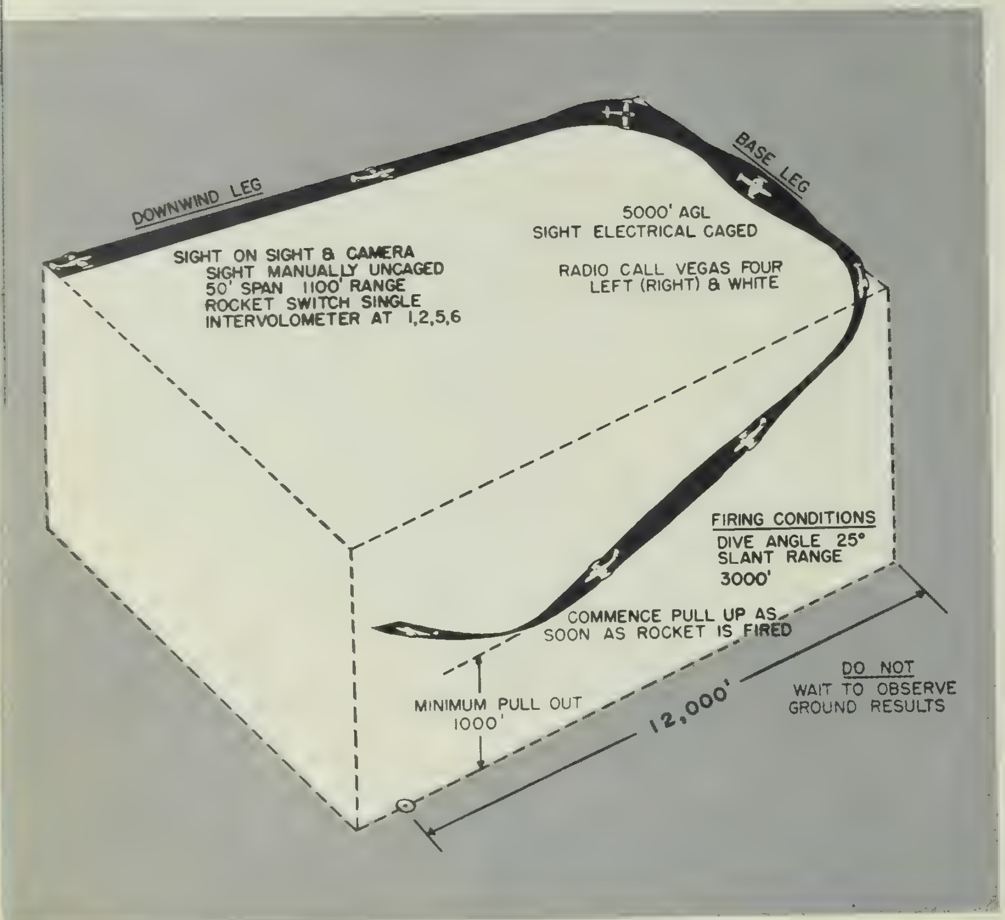


Fig. 4. In all High-Angle Rocket firing sight is put on proper wing span setting on downwind.

below 35 feet. A pilot is warned on his first foul, and if he fouls again, it is a zero mission and he is sent off the range.

After the final low-angle bombing pass, the flight pulls up on downwind leg for strafing runs. During the strafing mission the downwind leg is 500 feet higher than for the bombing runs: that is 3000 feet above the ground. The same relative spacing is maintained, with the base leg in the same position but at 3000 feet.

The turn off the base leg toward the target is not initiated as soon as on the low-angle bomb run and, in further contrast, is made with the least possible altitude loss. To make this turn properly a pilot should bring the sight picture through the horizon in a sweeping turn which will end with the sight in a direct line with the target but not directly on it. At this range the target is too small in relation to the pipper size and is very difficult to track. There is also the possibility of getting target fixation when a target is tracked through the sight too long.

After rolling out on target with the wings level, a pilot should have about a 20-degree dive. He should maintain track until approaching firing range, and at this point ease the pipper on the target. When sight pipper size and target size are in proper relation for the desired firing range, a short burst of no more than one second should be fired. Immediately after firing pull-up is initiated, once again with wings level, until the nose is 30 to 40 degrees above the horizon. After pull-up a steep turn back to the downwind leg is made.

At Nellis AFB the foul line for combat crew students is 1200 feet from target, and 800 feet from target for students in the gunnery instructor's school. Minimum pull-out altitude is 150 feet. The one-foul-warning, two-fouls-leave-the-range procedure is in effect on strafing missions, also.

### High-Angle Patterns

On these missions both the central tower and one spotting tower are used for scoring and observation. The same range is used, with the target a 150-foot circle.

The initial spacing pass is made in echelon at a minimum altitude of 2000 feet above the terrain. A minimum altitude is established to preclude wingmen in stacked-down position from flying into the ground.

The pass is made at release condition airspeed to get the proper release trim just as in low-angle work.

The break is every three seconds to establish spacing, and a climb is made to 6000 feet above the terrain on the downwind leg.

While on the downwind, rocket switches are set up for firing, and bomb and gun switches are checked to be sure they are off.

Then the sight is set for proper wing span setting for the desired release condition. Before takeoff, this should be set up and solved as an equation by putting the unknown wing span setting (X) over range drum setting (normal 1000 feet) equal to the diameter of the bombing circle over desired slant range. At Nellis, for example, this would be

$$\frac{X}{1000'} = \frac{150'}{3000'} \text{ slant range}$$

or approximately a 50-foot span on the sight. The important point here is for a pilot to know his span and set it on the sight on downwind. He should never attempt to set it or reset it after turning on final.

A turn onto the base leg is made, maintaining approximately 6000 feet above the terrain. The base leg should be approximately 12,400 feet from the target. A fairly tight turn onto target is initiated with minimum loss of altitude. The sight picture is brought from the horizon into line with the target but not directly on it. If turn onto final is made correctly, the aircraft will be in about a 30-degree dive, with the wings level.

Track is maintained until approaching firing range, which can be determined by the relation of the reticule size in the sight and target size. This reticule size was determined by the span setting and the range setting of sight on downwind leg.

When the reticule size is the same as the major axis of the bombing circle, the aircraft has reached release condition or predetermined slant range. In this case, 3000 feet as set up in the formula.

At release condition a pilot fires his rockets and immediately starts a pullout. DO NOT WAIT TO OBSERVE GROUND RESULTS. If a pilot attempts to observe his hits he can get too low on pull-out and may have to pull excessive G to keep from hitting the ground.

Again, the pull-out must be made with wings level until the nose is 60 degrees above the horizon. A turn back to the downwind leg is then initiated and the aircraft leveled off at 6000 feet.

Fouling minimum is 500 feet above terrain on pull-out. Once again two fouls mean loss of score and an order to get off the range.

After the last rocket pass is made, a pull-up to 8000 feet above the terrain is made, and the same spacing is maintained on the downwind leg. After rolling out on downwind, rocket switches are turned off and bomb switches are set up. Sights are reset to the wing span setting for the slant range to be used on the bomb run. (In this case a 4300-foot slant range, with a 35-foot sight span.)

In high-angle bombing the aircraft is flown somewhat slower on base leg, and approximately 4000 feet closer to the target to increase dive angle. Pattern altitude is 8000 feet above the terrain. The turn onto final is an over-the-top turn, with a reversal onto target. This is used primarily to assure proper dive angle, as a turn underneath or diving turn would result in too much loss of altitude in the turn, causing an improper, shallow dive angle.

The sight is again brought in line with target but not directly on it. A pilot must maintain track until reticule size and target size are the same. Angle of dive is 45 degrees, and the bomb is released at 4300 feet slant range. As stated before: DO NOT WAIT TO OBSERVE GROUND STRIKE.

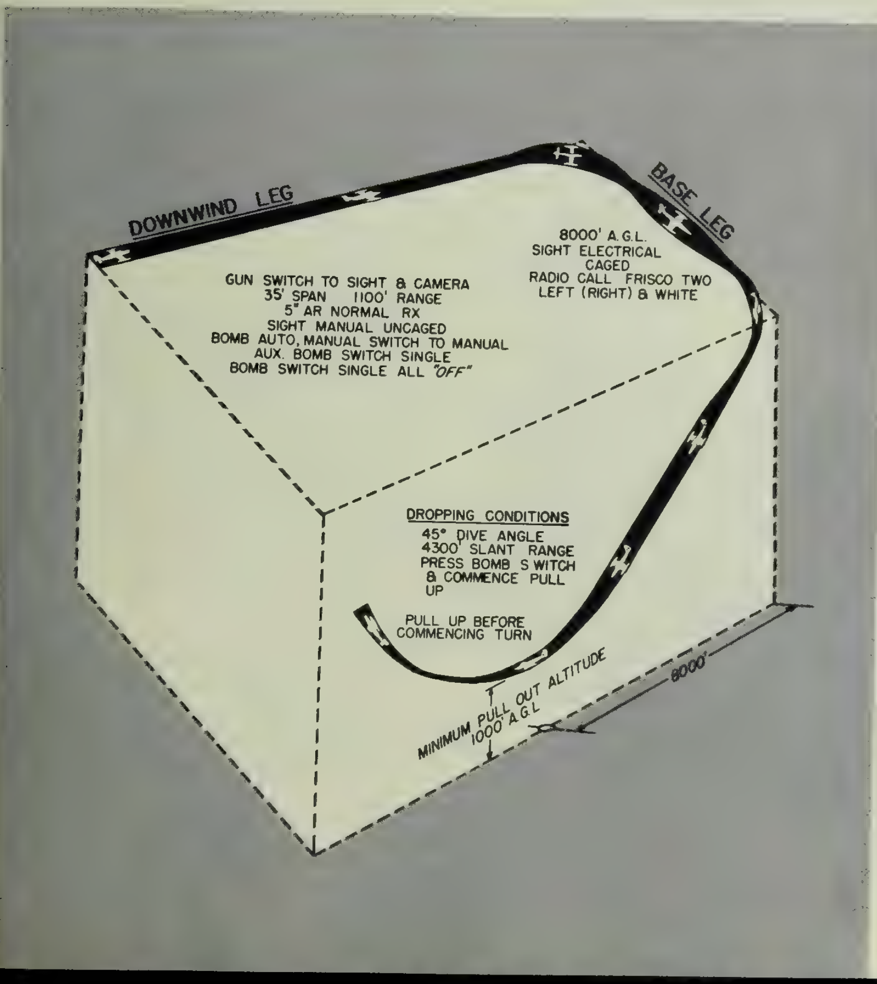
Here also pull-out is made with the wings level, with the nose of the aircraft 60 degrees above the horizon. Minimum fouling altitude for this mission is 1000 feet above the terrain, because of the steep, 45-degree angle of attack.

Care must be observed in all high-angle work to be sure release or firing is accomplished at the proper altitude. Otherwise it is likely that a pilot will pull excessive G, because the pull-out will be initiated too low. Some pilots tend just to release or fire and haul back on the stick (especially bad in rough air) instead of trimming their aircraft on the spacing pass and leaving it alone.

A pilot is required to call in on each pass in both low and high-angle work as mentioned previously, calling left or right range site and the color of the range panel. The instructor calls the end of each phase on all gunnery missions.

At Nellis, range officers are qualified IPs.

Fig. 5. In High-Angle Bombing, turn onto final is over-the-top, with a reversal onto target.



On every air-to-ground mission at Nellis an SOP is set up to cover any foreseeable emergencies.

In the event that a pilot loses his primary radio channel, he is required to go by the tower, on the same side as his gunnery passes, at 300 feet, rocking his wings. He maintains his spacing in the pattern but refrains from firing. He then switches to his secondary channel. If this also is inoperative, he maintains spacing, makes another pass at 300 feet, rocks his wings, breaks in the opposite direction to traffic and goes home.

If a pilot finds something is wrong with the plane and has no radio, he can still request assistance or escort home. He can fly a rectangular pattern, 1000 feet above base leg altitude and the flight leader then will cancel the mission, join up and escort him home.

### Air-to-Air

After establishing contact, both visually and by radio, with the tow pilot, the flight leader makes a spacing pass with his flight in trail, approximately five ship lengths separation between planes.

If right hand firing passes are to be made, the pass is made level with and to the left of the tow aircraft. If left hand firing passes are to be made, the pass is made level with and to the right of the tow plane. The leader breaks up and over at an angle of 60 degrees to the tow aircraft flight path and in a steep climb. The rest of the flight follows suit and establishes proper spacing.

After breaking at a 60-degree angle, the turn is reversed, and the tow ship is picked up visually again from the other side of the canopy. The climb is continued at an angle to the flight path of the tow aircraft that will place the fighter 6000-8000 feet out and 4500 feet above it. This position will be line-abreast of the tow aircraft, and commonly is called the *perch* position.

Attack is initiated from the perch, with proper airspeed and power setting, by a nose-low diving turn into the target. At this time the target is observed through the top of the canopy, while the majority of altitude is lost in the turn. The diving turn has a two-fold purpose: it increases airspeed and precludes the possibility of collision with another aircraft in the pattern positioning on the perch.

**At the gunnery meet, radar was used to detect altitude errors. This helped minimize fouling.**

During this diving turn the aircraft is physically forward of the tow target (not the tow aircraft), but the sight is pointed slightly behind the target. At an altitude approximately 1000-1500 feet above the target and approximately 4000 feet out from the target, turn reversal is initiated so that the fighter is 90 degrees to the target. Now the sight moves from a position slightly behind target to one slightly forward of the safety webbing. At this point a pilot should begin tracking the target, correcting his line of flight and checking airspeed.

When the line of flight is established, he allows the pipper to slowly drift back onto the target bull and maintains this position until firing range is reached. Firing range is normally recognized by the comparison of pipper size in relation to target size or bullseye.

In the final stage of the pursuit curve, an aircraft normally will be approximately 1500 feet from the target, 500 feet above target altitude, varying from a minimum of 15 degrees angle-off to a maximum of 45 degrees angle-off. Firing position is 1000 feet from the target, 250-300 feet above target altitude. Firing minimums are 600 feet and 15 degrees angle-off.

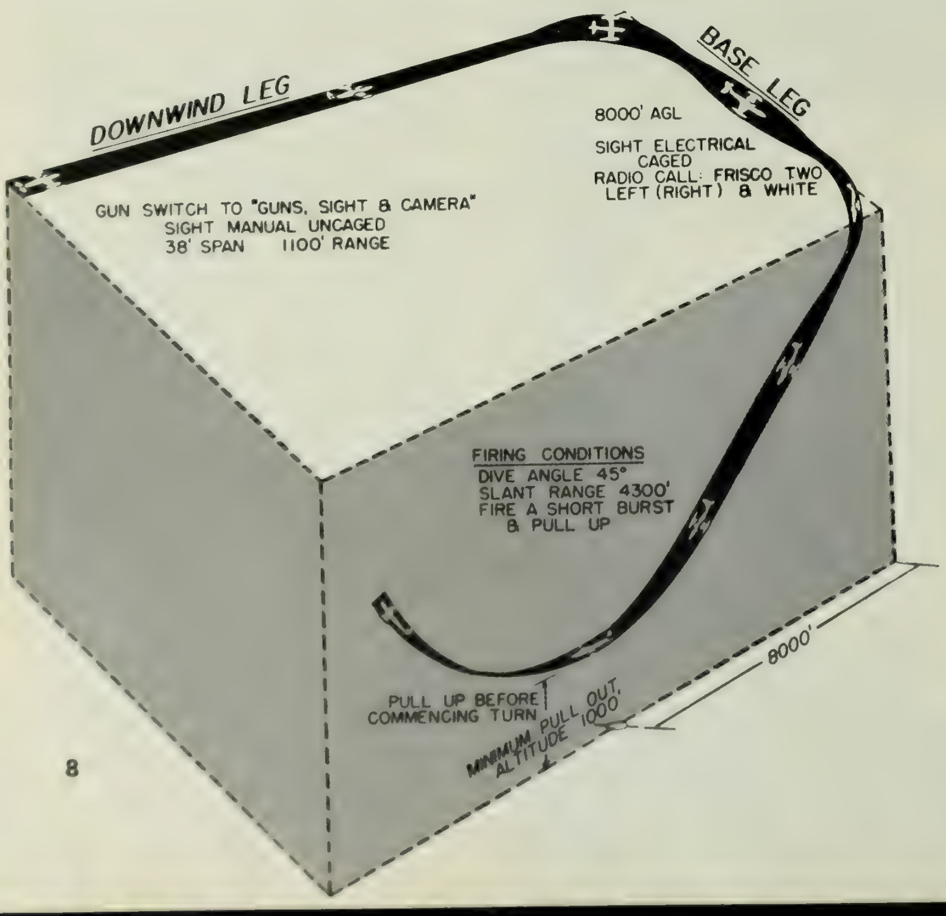
Breakaway is made behind and above flight level of the target. This enables the fighter to parallel the tow aircraft flight path at the same altitude, until passing the tow ship. A pilot, after passing the tow aircraft, should again initiate a steep climbing turn, 60 degrees to the tow ship flight path, and reposition himself on the perch.

The two most common errors in air-to-air gunnery are attempting passes at too low an angle-off and at too great an angle-off.

A pass made at too low an angle-off should be noticeable immediately to a pilot. His aircraft will close on the target very slowly, and he will pull only 1 or 2G maximum. This pass usually ends up with the fighter in trail of the target, which, as the angle decreases, will tend to appear wider than it is long. At no time should a pilot fire from this position because of the danger of hitting the tow target aircraft and the poor depth perception caused by the small target area.

A pass at too great an angle-off can be recognized by the high G forces (5 to 6G) required to track the target. This error should be corrected by repositioning the fighter in

Fig. 6. A High-Angle Strafing pattern is identical to that flown for high-angle bombing phase.


DOWNWIND LEG
BASE LEG
8000' AGL
SIGHT ELECTRICAL CAGED
RADIO CALL: FRISCO TWO LEFT (RIGHT) & WHITE
GUN SWITCH TO "GUNS, SIGHT & CAMERA"
SIGHT MANUAL UNCAGED
38' SPAN 1100' RANGE
FIRING CONDITIONS
DIVE ANGLE 45°
SLANT RANGE 4300'
FIRE A SHORT BURST & PULL UP
8000'
PULL UP BEFORE COMMENCING TURN
MINIMUM PULL OUT, ALTITUDE 1000'

This joker scored the wrong kind of hit!

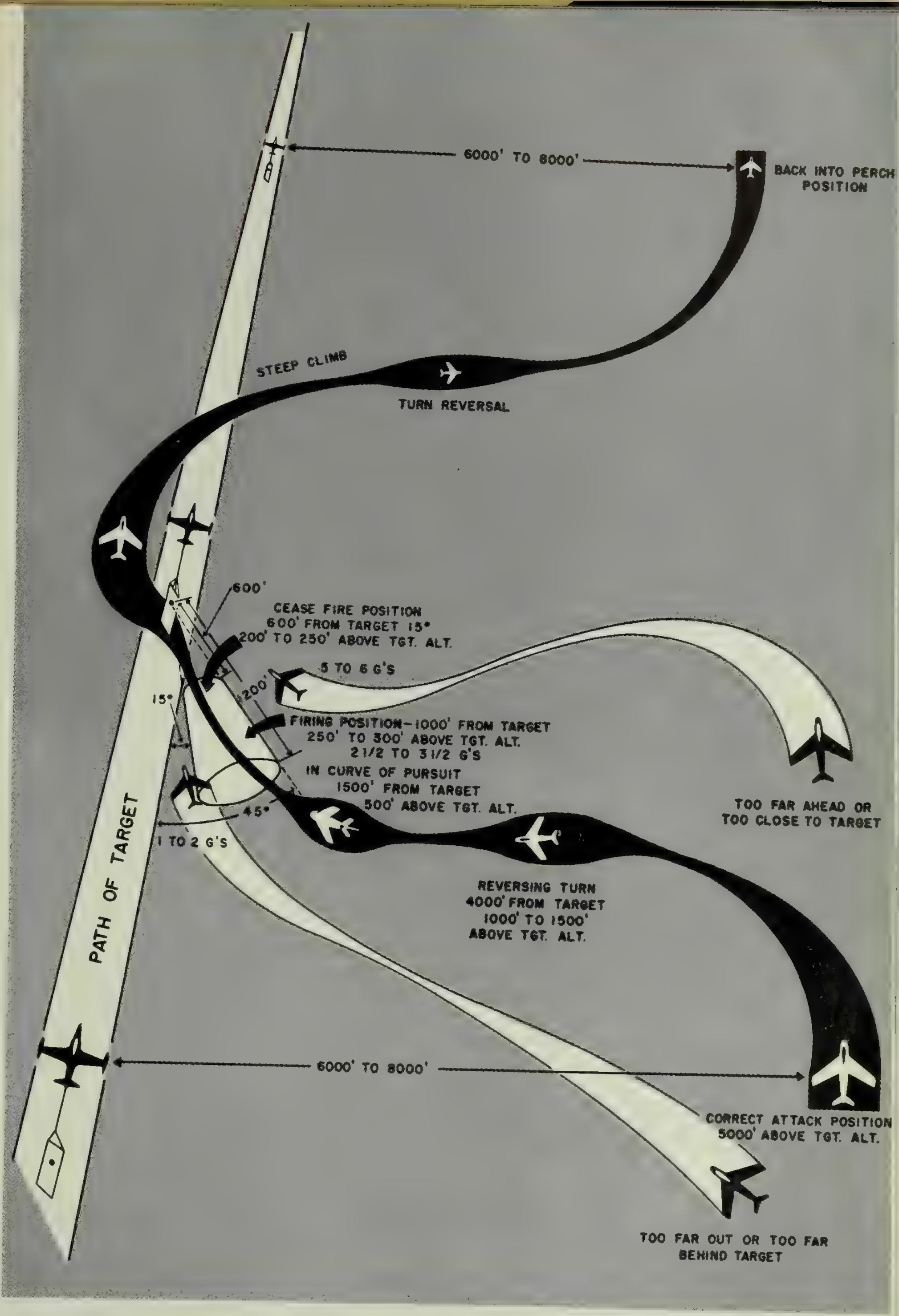


Fig. 7. Correct angle-off of 15 to 45 degrees is a must when flying an Air-to-Air mission.

relation to the target in reversal turns on subsequent passes.

If at any time a pilot finds himself in a tail chase position, he should immediately break off the pass and call, "Making spacer." This is extremely important, as the next man in the pattern, if positioned correctly, will be in firing range at about the time the first aircraft passes the tow target and may not observe it because of his attack position. After making the spacer call a pilot should immediately start a climb, and cut to the inside of the gunnery pattern only after he has the attacking aircraft in sight.

All aircraft call "in" before turning into the target and call "off" when passing the tow ship. Before a pilot initiates an attack, he must have all aircraft in flight and the tow plane in sight. At no time will a pilot start an attack before the preceding aircraft has started his turn reversal. Care should be taken when repositioning on the perch, as the pilot in front will be initiating his attack just slightly below and behind.

The flight leader calls his flight immediately prior to making the last pass in the mission, warning that this is the last pass. After the last pass all pilots call the flight leader to state that gun switches are off, sight is caged and circuit breakers pulled, if applicable.

Before each mission, regardless of type, all aircraft are armed at a position adjacent to the takeoff runway, with armament pointing toward an uninhabited area. As a pilot pulls into position for arming, he rechecks to be sure the armament switches are off and places his arms outside cockpit to indicate that all is clear.

De-arming procedure is the same but at the opposite end of the runway. Any aircraft with automatic chargers are de-armed while still at the end of the runway.

At Nellis AFB each phase of a mission is briefed by the flight commander, with further individual briefing by the instructor immediately prior to the mission. After the flight a de-briefing is held, and the instructor pilot points out mistakes and improper techniques to his students. Cameras are used on each flight, and the film is assessed to further analyze each phase of instruction.

The people at Nellis believe they produce the finest fighter pilots in the world. That they have succeeded in the past is evidenced by the record of the Nellis graduates in Korea. They also believe that the procedures and patterns they have set up are reducing accident potentials, and from here it looks as if they are right. ●

# SLANT RANGE ANGLES

*The problem of visibility and cloud height in the approach zone has been investigated during the past few years by eighteen separate countries, including the United States. The specific problem of pilot's slant range visibility or "effective pilot ceiling" was recognized as early as 1949. Two articles appearing in Flying Safety Magazine (May and September, 1953) shed additional light on this problem.*

*The following information was supplied by Air Weather Service. Although no firm cure-all has been developed, pilots will be interested in the thinking and planning currently being employed to solve the slant range problem.*

JUST what is the definition of a meteorological obscuration?

It is any element which obscures or partially obscures the sky. The problem to be discussed in this article, however, is limited to those obscurations which are touching the earth's surface. These are commonly called "surface based obscurations" and are reported as "partial obscurations" (—X) and "obscuration" (X).

During the early years of aviation, when meteorological practices were being developed to satisfy aviation requirements, the concept of "ceiling" height was developed. This concept involved measuring or estimating the vertical visibility from the surface. With obscurations (clouds) based aloft, this vertical visibility was the distance (height) of the base of the obscuration above the surface. But when the cloud base was on the ground, the ceiling was not reported as zero. The vertical visibility distance was reported (as some multiple of a reportable ceiling increment). The practice of reporting vertical visibility was applied to all ceiling conditions, whether cloud ceilings, or fog, rain, snow, haze, smoke, dust or any other type of obscuration which could obscure the sky. This method

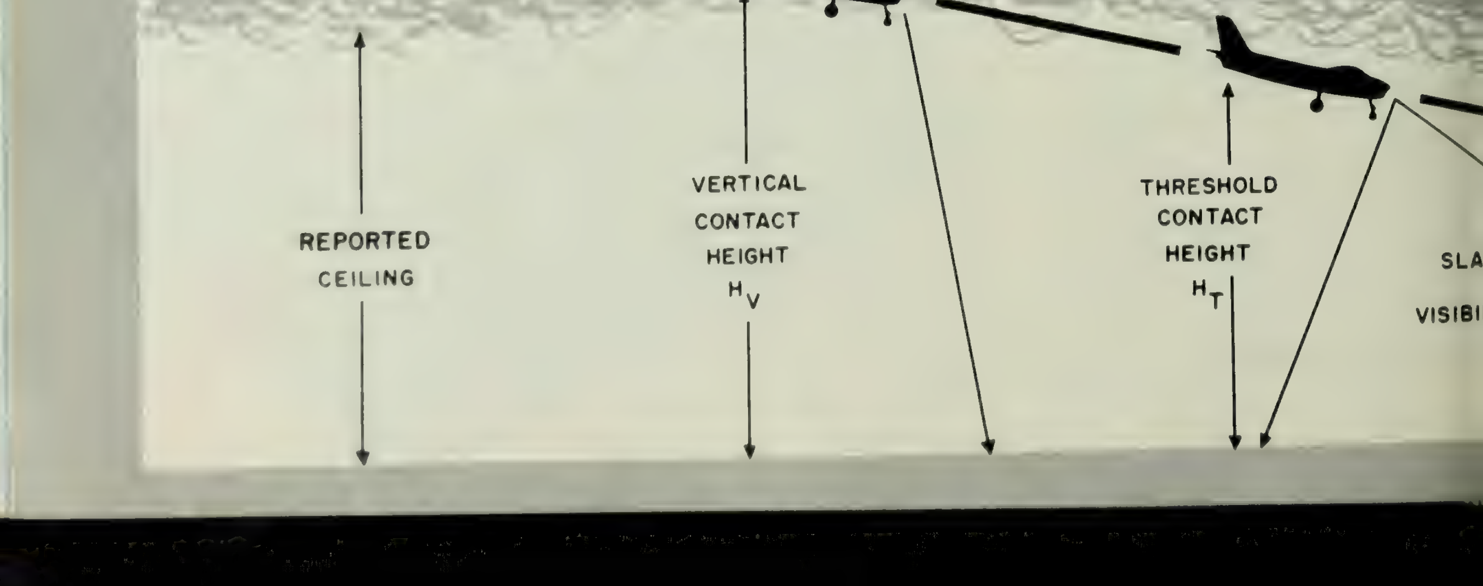


FIG. 1

of reporting proved fairly satisfactory in the past for several reasons.

Aircraft operations were not normally conducted under very low weather conditions, and possible reporting errors were not therefore of great significance.

The method developed was a logical approach to determining the ceiling. No refinement appeared necessary because ceiling reports coincided with pilot reports of broken or overcast cloud bases, which are the types of ceilings usually encountered.

Why, then, has the obscuration problem developed? First is the constant lowering of weather minimums required for aircraft operations (a 500-foot error in a reported 1500-foot ceiling is of small importance when compared to this same error in a reported 500-foot ceiling.). When we report conditions approaching VFR minimums, the pilot is highly indignant when he finds conditions existing which are too low to allow a safe landing. The difference between what we report and what the pilot reports often exceeds the pilot's margin of safety, especially when we report (X) or (—X).

This apparent discrepancy is not usually of vital importance to the pilot of a conventional aircraft. If he finds conditions too low for safe landing, he can make a go-around and proceed to his alternate. However, the advent of jet aircraft has changed all this. It is now of vital importance that we report what the jet pilot will find when he approaches. This is of prime importance because, in many instances, if not in most instances, the jet pilot must commit himself to a landing from altitude, not from his approach. He can't approach, go around, and then go to his alternate. He must know if he can land . . . or proceed to alternate before he begins his descent.

We all have learned that there are discrepancies between the official observation and the pilot's report. Why? Simply because we can't observe what the pilot will see, and because we can not observe, measure or determine slant range visibility when a surface obscuration is present. The net result is that we report vertical visibility as the ceiling. This is the pilot's vertical contact height, if his visibility down is equal to our reported visibility up. (See Fig. 1.) However, this is not the ceiling height which the pilot will see or report because:

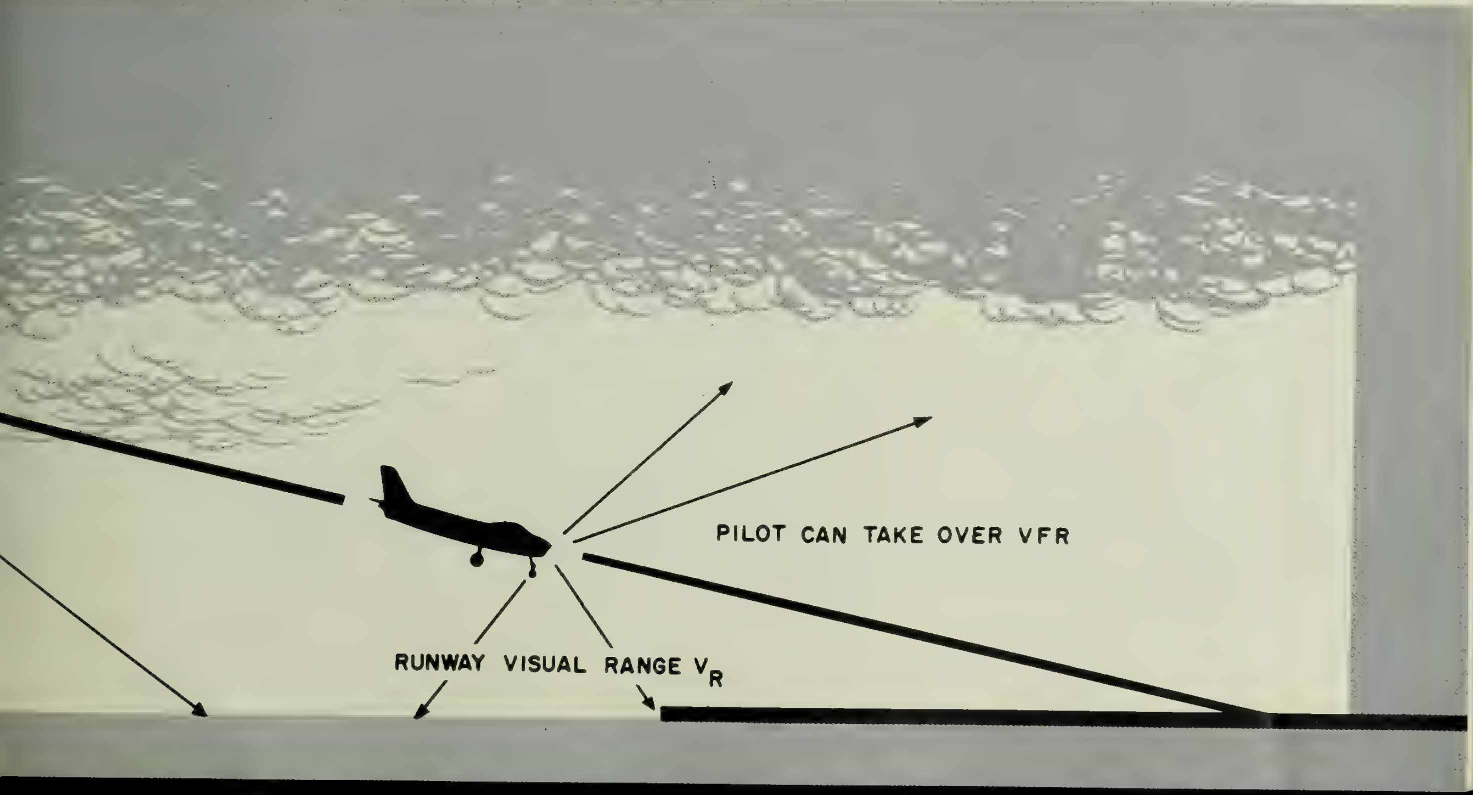
- The pilot is not peering between the rudders for the ground. He can't, even if he wants to. Instead, he is flying by means of instruments down the descent path.
- Even if he made vertical contact, he has visibility *only* in this straight down direction. He can't go VFR and complete, from that altitude, a visual approach.

The ceiling height which he will report is the altitude at which he is first able to see a sufficient ground distance ahead of the aircraft such that he can go VFR and remain so through his landing roll. (Ht. in Fig. 1.) This is variously called "threshold contact height" or "Effective Pilot Ceiling." It is the "ceiling" as far as the pilot is concerned, because he has slant visibility sufficient to "go VFR." (If no obscuration is reported, the cloud ceiling height is also the pilot's ceiling height, since he does have slant visibility. In this case, vertical visibility will give the pilot the correct ceiling, but *only in this case*. See Fig. 2.).

So you see, the discrepancy arises when we report one element while the pilot reports another. The danger is obvious. We report one element which the pilot interprets to be another element. The significance of obscurations now also becomes apparent. These are the conditions under which it is impossible to report the "effective pilot ceiling," and the thing we do report is misinterpreted by the pilot to be the "Effective Pilot Ceiling."

Recently we have begun to report in Sequence Remarks the amount of sky obscured by a partial obscuration. This is the first step taken to clarify reported conditions. This does not solve our problem, however, since a partial obscuration (defined as a surface based obscuration through which vertical visibility is unlimited) can also create an "Effective Pilot Ceiling." This is so because "Effective Pilot Ceiling" is tied to slant range visibility, not vertical visibility. The Directorate of Flight Safety Research has suggested that we cease reporting obscuration "ceilings" altogether in order to stop confusing the pilot.

Actually, the entire obscuration problem can be stated simply to be the problem of "slant range visibility" in the approach zone. Measurement of



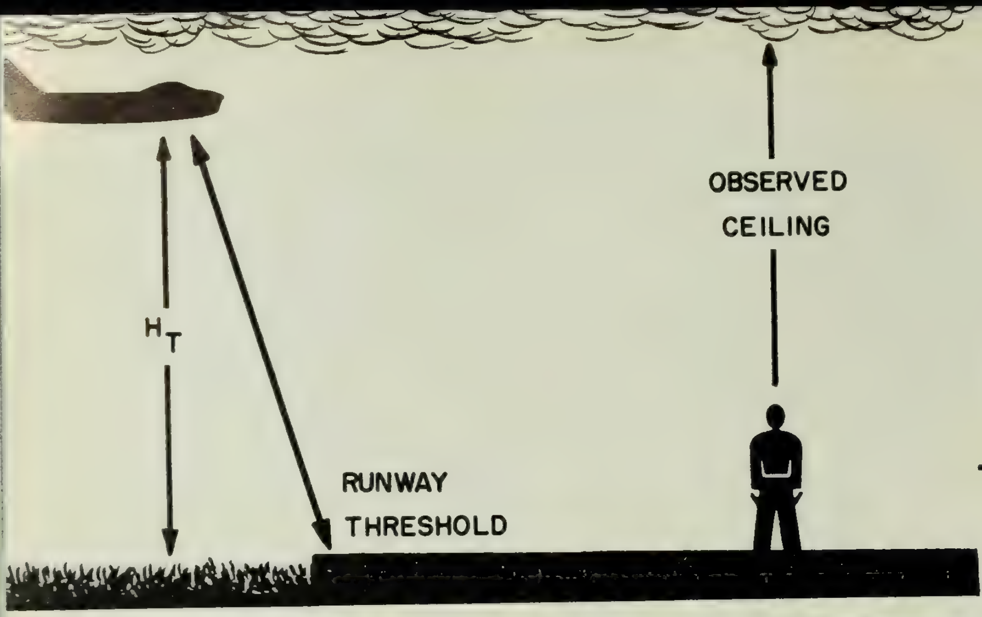
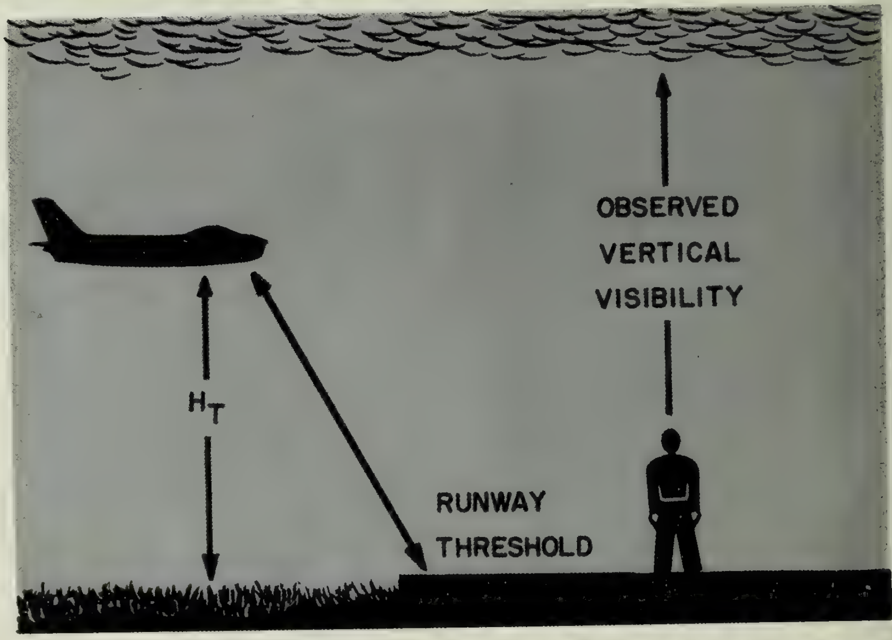


Fig. 2. With no obscuration present, the ceiling, as reported by the weather observer, is the same as the pilot's threshold height.

Fig. 3. With obscuration present, the weather observer's reported vertical visibility is greater than the pilot's threshold height.



this element has been, and is presently being investigated by several agencies both within and out of the United States. The International Civil Aviation Organization included this item as the first on its agenda at last year's Air Navigation Conference at Montreal. The ICAO is presently collecting all available information on the problem as is the Subcommittee on Meteorology of the President's Air Coordinating Committee. The British, French and Dutch have all investigated the problem, and Sperry Gyroscope Company is presently engaged in a research project under contract from the Air Navigation Development Board.

The Sperry project involves collecting and evaluating data from:

- A standard Weather Bureau Station.
- Transmissometers and rotating beam ceilometers (installed on the field and in the approach zone).
- Flights during about 500 low ceiling-low visibility approaches made at MacArthur and other fields on Long Island and in the New York area.

This data, when evaluated, may enable us to adopt the suggestion of Flight Safety Research, or to come up with other changes in our reporting procedures so as to report the actual flying conditions which pilots will find. The Sperry report on this project is scheduled for publication about 1 September of this year.

This process of educating the pilot should be of some help until we get the real solution: a revision of reporting practices which will eliminate the built-in confusion of our present reporting methods.

At the present time, and from information presently available, we have two possible approaches to our obscuration-slant visibility problem.

- The first and most desirable approach is to find a method of computing and reporting the "Effective Pilot Ceiling" or "Threshold Contact Height" from elements which we can presently observe and measure. This computation should lend itself to application at any aerodrome where trained observers take the observations. This method should report a "ceiling" height, since one of the MET elements which determine aircraft operating minima is the "ceiling," and because this element lends itself best to use by the pilot, who flies heading, airspeed, rate of descent, and ALTITUDE when making his instrument approach. To substitute a *time* or a *distance* element for the "ceiling" would only increase the pilot's workload. We expect to be able to determine if it is acceptable to report an "Effective Pilot Ceiling" corresponding to the "vertical visibility" ceiling by correlating presently reported elements and pilot's slant range obtained from the Sperry data.
- If we can not find a suitable method for determining "effective aircraft ceilings" and "pilot's slant range," we may be forced to cease reporting "obscuration ceilings." This will force the operators to completely revise the present system of determining operating minima, and may also involve other problems not presently anticipated. ●

# Keep Current

## NEWS AND VIEWS

**Flak Is Outlawed**—"Irate farmers who have been shooting at low-flying aircraft that allegedly disturbed their stock had better hang up their shotguns after 1 July in N.Y.

"On that day, under a bill approved recently by Governor Dewey, the willful discharge of a firearm at an airplane, whether in the air or on the ground, becomes a felony.

"The law authorizes a jail sentence of up to twenty years if 'the safety of any person is endangered' by the shooting.

"The first draft of the bill provided the same penalties for throwing 'stones or other missiles' at airplanes. It was amended late in the session to cover only the firing of guns."

(But shotguns are still *de rigueur* for disturbing a farmer's daughter!)

**Flight Safety Foundation**

**It's the Way It Bounces**—After banging around the world for lo these many years and suffering numerous bruises, I'm partial to those flights where a stewardess says, "May I help you fasten that safety belt?" You never know when the sweet gusts will sprawl her in your lap. But, with this Passenger Basic AFSC that I hold, I find most of my orders specify military air; hence, usually, no lovelies to get sprawled with.

Even though I can't toss with a stewardess in a thunderstorm or enjoy some intimacy in clear air turbulence, I WANT TO BE STRAPPED IN REAL TIGHT. Further, I want some warning from the pilot, crew chief or radio operator . . . anybody. I once rode the mountain wave in the lavatory. It was bruising and — to say the least, embarrassing.

The following excerpt from an airline vice president in charge of operations to his pilots is appropriate to the military:

"The increase in speed in modern aircraft has been accompanied by an increase in the number and severity of passenger and attendant injuries resulting from turbulence. Some of these occur in clear air turbulence. Others occur in frontal or thunderstorm areas where turbulence is known to exist.

"In practically all cases the seat belt was not fastened. Generally, this was because the sign was not on, or had not been on long enough for the attendant to check the belts . . ."

Give the boys in the back room a break. When you *expect* turbulence, allow time for them to break up the card game, drain the coffee cups and secure their belts. After all, it gets real old in a hurry when a man finds himself spread-eagled five feet in the air, about to stall in on a bucket seat.

**"Quac"**—A new, high-performance computer, capable of accurately programming over 20 separate flight operations simultaneously, has been developed and built by Northrop Aircraft, Inc., under contract to the U. S. Air Force.

The computer accomplishes this task by simultaneously picking up flight data, performing mathematical computations, timing and recording navigation directions, remembering and sending out flight instructions over a long period of time.

This machine, called a Quadratic Arc Computer and nicknamed "Quac" by the engineers who designed it, is an extremely compact device when its ability is considered. The computer measures five feet long, 40 inches wide and 33 inches high.

"Quac" is made up of over 6,000 electronic parts. It can "think" at the rate of 5,000 calculations per second and store up 2,600 digits in its memory system.

**The "Gee Whizzer"**—Ten months ago the U. S. Air Force, in a succinct 52 words, one of the briefest new-aircraft announcements on record, disclosed a contract with Lockheed for prototypes of the XF-104 jet fighter, called the "Gee Whizzer" by test pilots who have flown this new aircraft.

Recently, the USAF announced that this new member of the team is flying successfully — that Lockheed put the sleek sliver of aluminum in the air only a year after it was ordered. The XF-104 made its first flight in February, 1954, at Edwards AFB, Calif. "Designed to establish local superiority in a given area by sweeping the skies of enemy planes," as USAF announced, the XF-104 has been unofficiallly reported to be a light-weight fighter plane, which is unusually fast.

"This contract with Lockheed represents one part of the U. S. Air Force's continuing program to press aggressively the development of superior weapons," according to the Secretary of the Air Force, Harold E. Talbott.

The contract with Lockheed Aircraft Corporation was signed in March, 1953, and the XF-104 rolled out of Lockheed's Burbank, Calif., plant in February, 1954.

Following roll-out, it was trucked to the Mojave Desert test facility, where it is still undergoing airworthiness tests.

A Curtiss-Wright J65 jet engine powers the new fighter.

**Glare**—The glare of the runway lights appears to be a strong contributing factor in some accidents. Depth perception and orientation in space are impaired by glare. If sudden changes in the intensity of the most prominent feature in the visual field (the runway lights in this case) are made, false impressions of distance are induced. This effect might be considered an illusion. Decreasing the intensity of a light makes it appear to be farther away when there are no other clues to distant judgment. For this reason changes of the intensity of the runway lights during the last seconds before landing should be discouraged. Tower personnel should be instructed about this phenomenon. Pilots should be similarly instructed so that they request the necessary changes early in their approach. Pilots must be aware of the above mentioned effects so that they mistrust distance judgments affected by light intensity changes and in so doing can help avoid accidents. ●

KNOWLEDGE

# WELL DONE

TRAINING

**Lt. Jack R. Lovell**
**97th Fighter-Interceptor Sq.**
**Wright-Patterson AFB, Ohio**

While shooting a GCA in an F-86D, Lt. Jack R. Lovell was told to take his plane around from an altitude of 700 feet on final approach. Lt. Lovell added full power and raised gear and flaps, clearing to the right of the runway.

Immediately the F-86's engine lost power, then surged again. The RPM fluctuated between 60 and 90 per cent. Lovell turned back to the runway, retarded the throttle to idle and switched to the emergency fuel system. After switching, the engine remained in idle RPM and he declared an emergency. At this time Lovell was on a downwind heading at 800 feet. After planning his base leg carefully, he was able to lower gear and flaps on final and make a downwind landing.

Well Done!

### Captain Harry A. Brown, Jr.
**331st Fighter-Interceptor Sq.**
**Suffolk Co. AFB, New York**

While climbing an F-86D to altitude on a local test flight, Capt. H. A. Brown, Jr. noticed that the airspeed indicator and rate of climb indicator were fluctuating. Capt. Brown leveled off at 17,000 feet and turned back toward his base just as the instruments became inoperative.

At this time, the aircraft developed electronic fuel control problems which finally resulted in a flameout at 14,000 feet over the field. After two unsuccessful airstarts were attempted, Brown set up a flameout pattern and made a successful deadstick landing on a 7000-foot runway, with no airspeed or rate of descent indicators. This was Capt. Brown's third successful deadstick landing in six months!

Well Done!

### Lt. John A. Sickel, USN
**84th Fighter-Interceptor Sq.**
**Hamilton AFB, Calif.**

While flying at over 40,000 feet, Lt. John A. Sickel, USN exchange pilot, had his F-94C's engine flameout. Base weather was 3000 feet overcast, 1500 feet broken. Lt. Sickel started a glide toward the field, homing on the local beacon.

Sickel arrived over the beacon at 20,000 feet and started a spiral descent while employing all airstart procedures without success. He entered a solid cloud layer at 9000 feet and caught his first glimpse of the ground at 3000 feet. Orienting himself, he lined up with the landing runway, slightly upwind of the high key point. He established a tight 360-degree turn while lowering the gear, using the emergency system and made a normal landing on the runway.

Well Done!

*In high performance aircraft,*

*on a collision course, you have only . . .*

# Short Seconds!

Colonel H. G. Moseley, USAF (MC) Chief, Medical Safety Div. D/FSR

RECENTLY a pilot who was undergoing training in a jet fighter aircraft returned from a skip-bombing mission and was somewhat concerned when his crew chief pointed out several dents in the leading edge of the wing, scratches on the bottom of the aircraft and pieces of Yucca cactus firmly embedded in the air scoop.

In this foliage-gathering mission, the pilot's wingman, who was flying behind him, was impressed with the low level of the pass, so low indeed that jet wash raised considerable dust in the passing.

All of which might be placed in the "Tut-tut, don't-do-it-again" category except for the fact that a number of other pilots have had similar experiences but leveled off a few feet lower, with rather dramatic results. If the pilot had stopped to calculate his dive angle and closing speed toward the ground, he would have realized that at the time he began his pull-out he was angling toward the ground at the speed of some 500 feet a second, and if he had delayed his pull-out as much as 1/50th of a second more, well . . . ? ? ?

There is little doubt but that the pilot was sincerely attempting to fulfill his mission of bouncing a bomb through a target and that he did not wilfully intend to give his wingman a case of near-nervous collapse by the maneuver. His near-miss was inadvertent as he would never have had this mishap had he realized the vital importance of two factors, both of which every jet jockey needs to know and respect. These factors are, first, the terrific, almost unreal rate of closing speed in high performance aircraft and, second, the built-in limitations of man whose reactions are appallingly slow when pitted against the rapidity of events which may be encountered in high speed flight.

Closing speed of high performance aircraft is something rather new to the human race. To grandfather it never meant much more than an occasional collision between a buggy wheel and the front porch step during the haste of getting grandmother to church. Even to father in the day of the Model T it seldom meant more than a crumpled fender and a ruffled disposition which could be straightened out by means of a pair of pliers and a bottle of beer, respectively. The driver of the modern car, however, has begun to learn more about closing speed and why to respect it. The

relative ease with which man has encompassed this new challenge is somewhat of a tribute to his ingenuity. Within a very few years he has learned to glance at on-coming traffic and decide with a certain degree of accuracy his ability to safely pass the truck in front of him. Subconsciously he has developed a third dimensional gage of a new phenomenon. And, one might add, Monday morning's papers contain some interesting observations on those who were unable to learn.

Yet, in spite of his experience on the highway, when man pilots a jet aircraft he encounters closing speed which has no earthly comparison and whose significance he has not yet learned to interpret at a glance. Therefore, it may be appropriate to take a more or less typical fighter mission, dissect it and look at the anatomy of this strange new force.

Inasmuch as high-angle strafing and bombing attacks are common maneuvers we can take a high-angle strafing mission in an F-86 with roll-in at 10,000 feet and pull-out at 1000 feet above terrain. Fortunately, it takes no Einstein to understand the time-space anatomy of this situation. There are just three factors in it: *direction, speed and recovery.*

In this mission direction is simple; once the nose of the aircraft is pointed 45 degrees below horizontal, it is established. There is only one nasty little complication. This will become apparent later.

The next factor is speed. This also sounds simple; once a velocity of approximately 450 knots is established we have the speed. Any questions?

At this point all who have no questions might reconsult their insurance agents, because just as two and two equal four there are two factors built into the problem which, if unaltered, may add up to an untimely end.

These factors are vital because the direction is down, and, to state it mildly, the aircraft is moving. As a result, a collision with the earth is sooner or later inevitable. Therefore, in any mission where speed toward the earth is established there must be an accompanying and equally important consideration of time. Not knowing the minimum length of time that the speed and direction may be maintained before change is essential can be placed in the same category as not knowing the gun was loaded.

There are many charts showing how long it takes to lose altitude in various degrees of dives at various

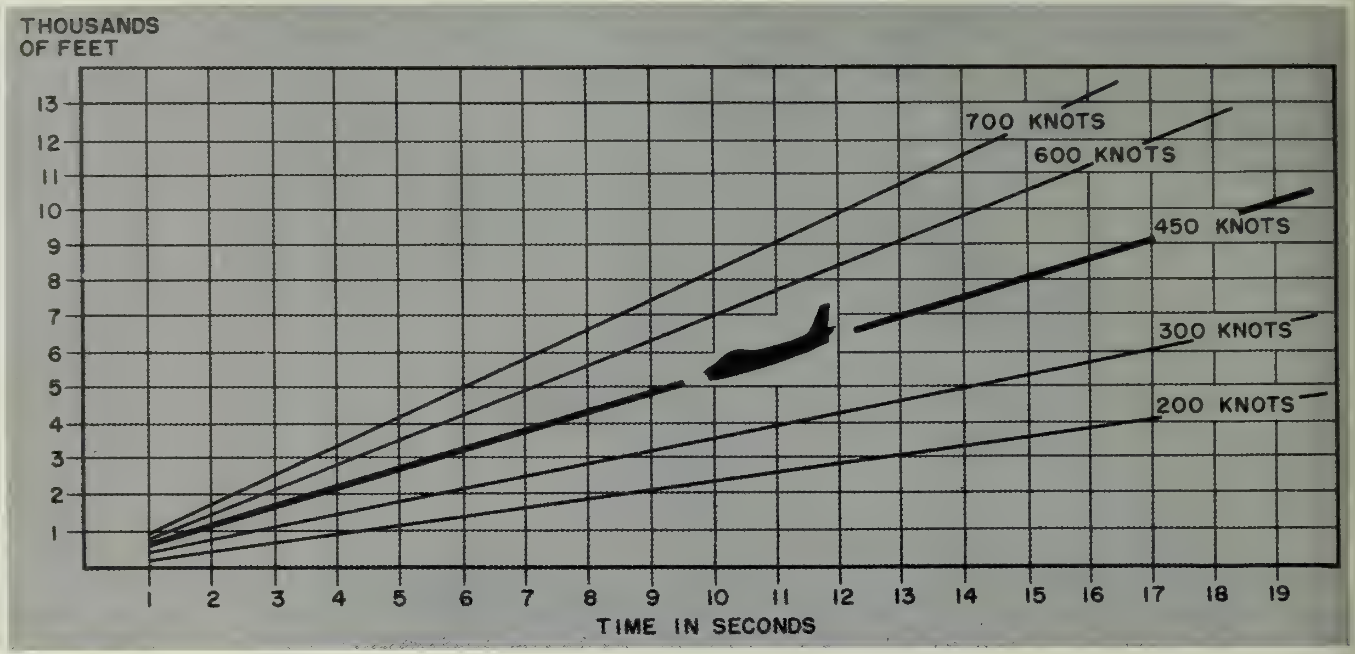


**Chart A. As shown by the chart, at 450 knots in a 45-degree dive, 9000 feet will be lost in about 17 seconds.**

speeds. An example is Chart A. In this mission we start at 10,000 feet and pull out at 1000, indicating that we have 9000 feet of altitude to lose. As can be seen by the chart, at 450 knots 9000 feet in a 45-degree dive will be lost in approximately 17 seconds. However, if we hold the dive for 17 seconds we will commit one more unpardonable error—that is the error of allowing insufficient time for recovery. Recovery is the last major factor in the relatively simple anatomy of a dive. However, we should take a long, careful look at this item, for recovery from a high-angle strafing mission brings into sharp focus some of the most critical hazards of rapid closing speed.

Flight surgeons and scientists have gone into long dissertations and have written reams concerning acceleration, G force and other physical laws of time, motion and space which are involved in changing the speed and direction of flight.

### Momentum and Inertia

However, the factors which most directly confront us in recovering from this dive are the forces of momentum and inertia. One of the peculiarities of nature is that when something is moving, it keeps right on moving in a straight line until it meets some form of resistance. And the heavier the object and the faster the speed, the more resistance it takes to slow it, turn it or stop it.

This tendency to keep on going is due to the object's momentum and inertia, and for the sake of simplicity we can think of these forces together as momentum. A baseball, after being pitched, continues in the direction it is thrown due to its momentum, and it is stopped by the resistance of the batter, the catcher, the solid earth or the friction of air. If a rock the size of a basketball is thrown with any force, neither the batter nor the catcher can stop it effectively and it will take considerable friction to overcome its momentum.

In the F-86 high-angle strafing mission we have committed several streamlined tons of aircraft to a speed approximately that of a .45 caliber bullet. Here we have momentum in truly awe-inspiring proportions, and it is momentum which will require tremendous resistance to change. Unlike the baseball, the only acceptable form of resistance we can use is the friction of air. With this friction we must both slow down the dive and change the direction of the aircraft by at least 45 degrees.

A speed of 450 knots is considerable, and a jet aircraft, even with dive brakes extended, does not offer much surface for effective atmospheric friction. Therefore, we need both time and distance to overcome speed. In fact we need so much time and distance to slow a nose-down dive that reduction of speed is only of minor importance in our problem of recovery. What is of paramount importance is change of direction.

It is the item of change in direction which is the toughest problem of all. It is something that every pilot is constantly confronted with, and it is so closely tied to fundamental laws of nature that it must be given monumental respect if human flight is to be successful. As we mentioned above, momentum tends to keep an object going at the same speed and in the same direction until it meets resistance. Thus, when an aircraft's nose is pulled up, the pilot tends to go on in the original direction, and G forces are created. These same G forces work on the aircraft structure and wings, and the more rapidly the direction is changed the greater become the physical laws pushing the aircraft and the pilot straight ahead. After a point neither the pilot nor the plane can any longer resist this force, and unconsciousness or disintegration occurs.

### Required Pull-out Time

It is appropriate here to look at Charts B and C to see the length of time which will be required to pull out of a 45-degree dive at 450 knots, at both 4 and 6G. At slower speeds less altitude is needed than is shown on the charts. However, the amount of G that can be used effectively on the aircraft and the time required to recover at this speed, must be computed well in advance. If insufficient time is allotted and the aircraft is committed to too low an altitude before recovery is begun, momentum and inertia, following the inexorable laws of nature, will take over and commit the aircraft to disintegration in the air or collision with the earth, no matter what efforts, threats or appeals the pilot may use.

The amount of altitude needed for recovery must be carefully computed, because it is least subject to compromise, and this altitude must be added to the distance above the ground wherein level flight is desired. Above that can be found the time allowed for aligning, sighting and firing. The successful pilot will know full well this time factor, because the seconds computed will be far more exact than his altimeter, and frequently more reliable than his vision.

For those who wonder why the altimeter is not reliable, it is relevant to note that a target and an altimeter cannot be simultaneously watched, and it is even more relevant to note that in high-speed dives the altimeter lag places the aircraft many hundreds of feet nearer the earth than is shown by the instrument. For those who wonder why vision alone is not a good substitute for timing a dive, it is well to consider the limitations of man and his reactions.

In considering man and his reactions, we can briefly review another accident. It is also true. It is chosen because it is typical rather than bizarre. The factors which caused it are still present. These causes are unchangeable. Only by knowing them can we prevent repetition.

This accident had its inception when a pilot, flying a jet interceptor found it rather monotonous making the usual camera gunnery passes at a bomber and requested permission from the bomber pilot to make a head-on pass. Permission was granted, and the interceptor pilot moved out ahead, oriented himself and waited for the bomber to appear. Eventually he sighted it approximately three miles distant and coming toward him. He swung in for his pass and then pulled up over the left wing of the bomber and away. He immediately noticed a severe yaw accompanied by buffeting and found

**Chart B.** This chart shows altitude lost in pull-outs from 30, 45, 60 and 90-degree dives from 10,000 feet at 6G.

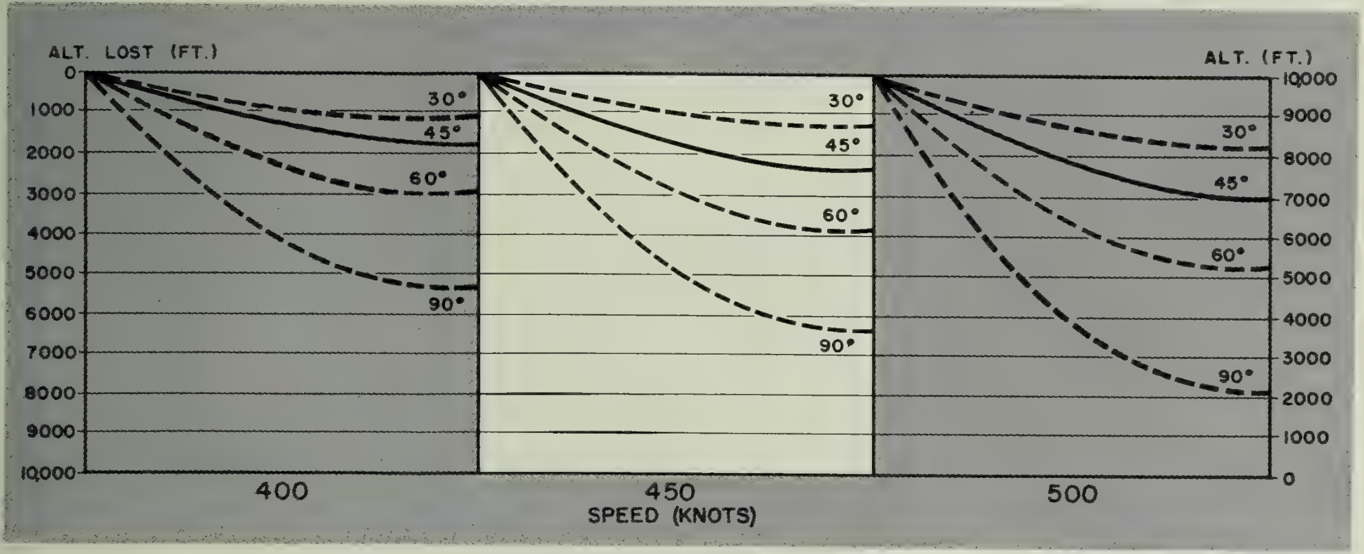
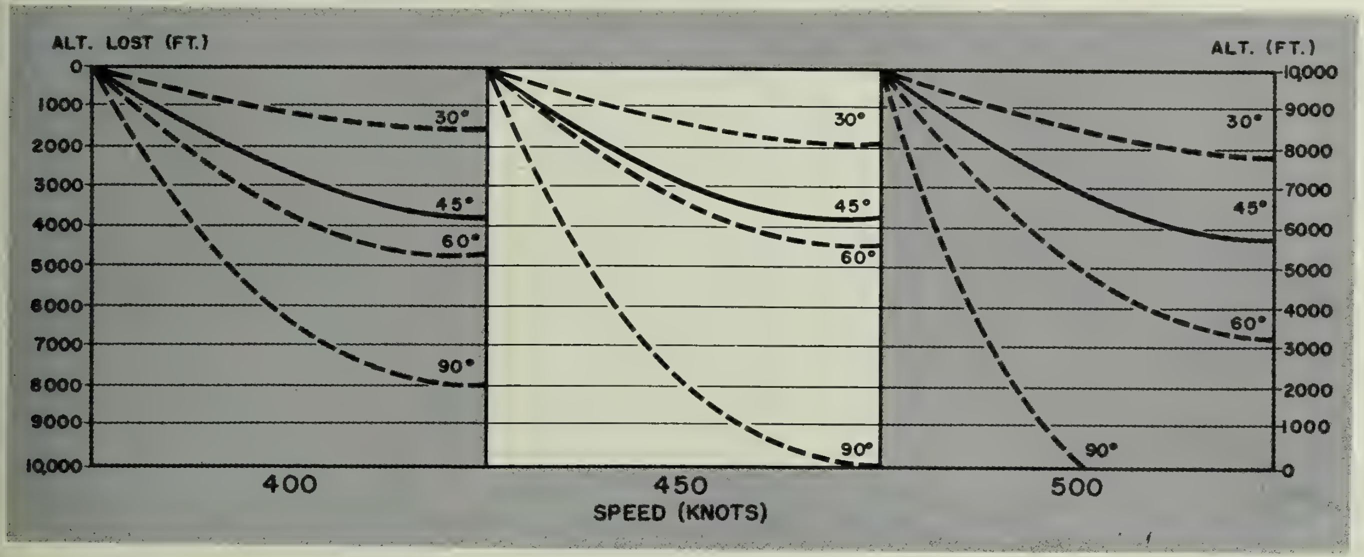


**Chart C.** Note increased loss of altitude when a pilot pulls 4G instead of 6G at 30, 45, 60 and 90-degree dive angles.



that he had a ruptured right tiptank. He determined that his aircraft was controllable and returned to his home station and landed successfully.

The fate of the bomber was different. With a piece of the wing sheared off by the interceptor tiptank, it went out of control, partially disintegrated in the air and crashed. There were no survivors.

Neither the bomber nor the interceptor pilot realized the odds against them when they set up this simulated attack. It is certain that had they realized it, they would never have tried the maneuver. Let us review the cause factors in this accident, because, as mentioned before, they are still present.

Primarily this simulated attack, like all head-on attacks, created a formidable closing speed. The bomber was traveling at 170 knots indicated, and the interceptor was coming toward it at 350 knots indicated. Thus, at their altitude they had established a closing speed of approximately 1100 feet a second. The rest is a story of human reactions.

### Reaction Problems

In considering man's reactions when confronted with such closing speed one finds that the first problem is one of visibility. Even on perfectly clear days it is difficult to see an approaching aircraft until it is quite close. The greatest distance at which a bomber can be seen is a little over seven miles, and a fighter a little over five miles. However, the probability of seeing an aircraft at such distances is about as great as seeing a grain of sand somewhere on a rug. It is not until an object is near enough to be relatively large that it is usually seen, even when searched for. So, as might be expected, the interceptor pilot first recognized the bomber when it was about three miles away. In some respects he was lucky, he might have been much closer before recognition dawned. If he had not been searching he might not have seen it at all.

However, the interceptor pilot did locate the bomber at a distance of approximately three miles. Here is where the plot really thickened, because while closing at a rate of 1100 feet a second a stubborn, uncompromising factor called time lag stepped into the picture.

What does time lag mean? It means it takes approximately 1/10th of a second for the nerves to carry what the eye sees to the brain and it takes approximately one second for the brain to recognize what it sees.

In turn, it takes approximately five seconds for the brain to make a decision when there are several choices. For instance, to decide whether to turn the plane up or down, right or left.

It takes approximately 4/10ths of a second for the nerves to carry that decision to the muscles and make them move.

What did this time lag mean to the interceptor pilot? It meant 110 feet in the 1/10th of a second for sight to reach the brain. It meant 1100 feet in the one second for recognition to take place. It meant 5500 feet in the five seconds spent in deciding how to line up. It meant 440 feet in the 4/10th of a second to react. All in all, it meant 7000 feet from the time the bomber was seen until it was lined up.

The die had been cast. Now the end was inevitable. Considering that the bomber was first seen at about three miles, or approximately 16,000 feet, and considering that 7000 feet were lost in the line-up, we now have 9000 feet separating the two aircraft, and it's time to fire away.

Here, again, time factors are encountered. We hold the course and squeeze the trigger. Four seconds and 4400 feet. We recognize we are getting close. One second and 1100 feet. We decide to break away. Luckily, the decision was made in advance of the attack to break up and to the right. No complicated choice here. Only one second for a decision. Only 1100 feet. And now only 4/10ths of a second to react to that decision; only 440 feet. However, we have precipitously obliterated another 7000 feet.

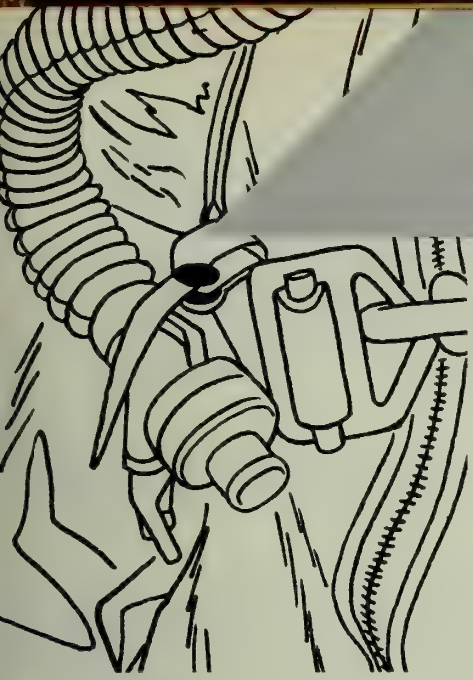
How much space remains? Approximately 2000 feet now separate the aircraft, and evasion has begun. Only it is started too late. Here, again, time lag steps in. This time it is not the lag inherent in the reaction of the pilot, but the time lag in the aircraft itself. It takes time to stretch the cables. It takes time to move the rudders. It takes time to change the airflow over the controls. Especially, it takes time to change the tons of momentum from their near-irresistible course. How much time elapses between pressing the controls and significantly changing the course of an aircraft? That isn't known exactly. Certainly more than a second. Probably more than two seconds. Some observers say five seconds.

In this case there were two thousand feet between the two aircraft; 1100 feet a second. Time ran out. This pilot learned the hard way.

Yet, those who cannot remember the past are condemned to repeat it. Recently two experienced pilots in jet fighters, disregarding instructions, decided to fly a head-on pass. It was the same story. The pattern was similar. Not much distance when they first saw each other. A fraction of a second for sight to reach the brain. A second for recognition. A few seconds for decision. A fraction of a second for reaction; another few seconds to decide upon the breakaway. It was their last earthly decision. Little else could be expected. Their closing speed was approximately 1700 feet a second.

However, the true significance of closing speed and human reaction does not lie in making head-on passes. It lies rather in the fact that in spite of high velocity and man's slow chemistry, flight can be eminently successful. Although the laws of nature appear to stand rigid and immutable in the paths of aerial conquest, they can be circumvented. To this end man has established the codes and rules of flying. Thus, the warnings of minimum altitude are designed to neutralize the momentum encountered in a strafing mission, and the rules of air traffic are established to avoid the awesome closing speed of on-rushing aircraft.

It is a wise pilot who will know well and abide by these rules of the game. He cannot change the laws which make them necessary. Nor can he alter the penalty of disregard. ●



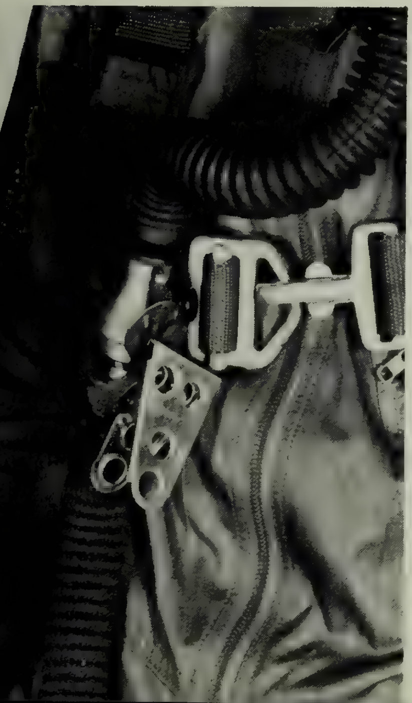
# LOOK to HOOK

THERE have been many reports of the separation of the oxygen-to-regulator disconnect during flight. If this happens at altitude the results are obvious. That thin air won't be doing the pilot much good, that's for sure. If he's lucky, he'll notice the condition before it's too late.

Another problem that crops up from time to time is the loss of the helmet and oxygen mask during ejection. By that we mean losses have occurred even though the visor was properly positioned prior to bailout, but the oxygen tubing was not secured correctly.

Investigation of these incidents has indicated that there are many different methods by which flight personnel are attaching the mask-to-regulator-tubing disconnect. And this improper securing of the equipment is causing many of the helmet and mask losses.

We've observed pilots and crew members attaching the disconnect to flight clothing, shoulder harnesses and parachute harnesses in many different positions. And applicable Technical Orders do not provide definite optimum arrangements for attaching the connector—yet.



Here are a couple of hints that should be of benefit to every man who goes charging off into the blue, and needs to use his oxygen mask.

When connecting the mask hose male connector to the mask-to-regulator tubing female connector, make certain that the connector is positively locked. This can be ascertained by listening for the connector to click when it locks.

In noisy areas, such as the usual flight line, it may not be possible to hear the connector click. In this case, look at the connector at the point of connection. When the connector is completely closed, the sealing gasket is compressed so that one-half of the gasket shows.

We suggest that flight personnel get better acquainted with the function of the disconnect by getting in a quiet area, listening for the click as a proper union is made and then looking at the gasket to see that only a half of the gasket shows after the connector is locked.

So much for making a positive connection for the mask. Now let's consider means of properly securing the oxygen hose to preclude loss of the mask in the event of a bailout.

The disconnect should be attached to the parachute harness chest strap as close to the center as possible. If you'll look at the accompanying photo and drawing on this page, you'll see what we mean.

The attachment strap on the male mask connector should be attached to the parachute chest strap by routing the connector strap under the chest strap, then around the strap twice and then finally snapping it to the connector.

Next, the female connector of the mask-to-regulator tubing should be connected to the mask male connector. Finally, the alligator clip should be attached to the mask male connector strap, as shown in the photo.

The alligator clip should be turned so that it is positioned next to the parachute chest strap. The free end of the mask connector strap should be put through the teeth of the alligator clip.

Push the alligator clip as close as possible to the snap fastener to take up any looseness. Any movement of the head that creates a pull on the mask hose fitting will be absorbed by the strap wrapped around the chest strap, thus preventing tension on the connector which possibly could cause separation.

Any pull on the mask-to-regulator tubing connector will be absorbed by the alligator clip, thus preventing tension on the connector which could cause separation.

If it should become necessary to eject from the aircraft, the following sequence of events will take place:

After ejection and during separation from the seat, the mask-to-regulator tubing which is attached to the seat will pull on the mask male connector before separation. This pull in turn will be absorbed by the mask male connector strap and then the parachute chest strap. The alligator clip will easily separate from the mask connector and strap. Thus, during ejection, the mask-to-regulator tubing will not tend to pull off the oxygen mask and helmet.

In general, WADC recommends the following simplified checklist:

- Attach mask male connector strap to parachute harness chest strap.
- Connect mask-to-regulator tubing female disconnect to mask male connector, listen for click and look to see that sealing gasket is only half exposed.
- Attach alligator clip to mask male connector strap.

As a rule we try to avoid quoting Technical Orders; however, in this case we suggest that pilots familiarize themselves with T.O. 13-1-37 and 13-1-38. These TO's cover proper fitting of helmets and masks. Sure, we know that personal equipment people have to follow the directions, but for your own sake, read 'em.

Just a couple of final do items:

Insure that your helmet chin strap is attached at all times and if a bailout becomes necessary, insure that the helmet visor is placed in the locked position before you squeeze that go-handle. ●

# the HOTTER the SHORTER

THIS month we are getting away from tornadoes and thunderstorms and other allied ills and concentrating on another type of problem. As you should be well aware, the length of a takeoff roll of any aircraft, particularly jets, is dependent upon air density among other things. This, then, means that DENSITY ALTITUDE enters the picture.

Failure of pilots to understand and consider the possible effects of density altitude variations on aircraft performance can and has resulted in some serious accidents.

A typical example occurred recently in a jet training aircraft at an air base located about a mile high. When the aircraft failed to become airborne after a ground roll of approximately 6500 feet on an 8000-foot runway, the pilot aborted the takeoff. The plane slid off the end of the runway and was destroyed. The pilot received major injuries.

Although the elevation of the field was only a bit over 5000 feet above sea level, the density altitude at the time of the accident was 8700 feet. The takeoff distance charts in the Flight Handbook show that a ground roll of 6600 feet was required for takeoff at the temperature, pressure and aircraft weight involved in this instance. In other words, the pilot aborted his takeoff attempt one hundred feet short of the point where the aircraft would have become airborne. It is apparent that the pilot was not aware of the longer takeoff roll required under the atmospheric conditions existing at the time that this accident occurred.

During the past year other similar accidents involving jet fighter aircraft occurred. In each instance no evidence of material failure or malfunction could be found.

In almost every case the density altitude was greater than the field elevation. The outstanding feature of these accidents is the fact that all involved aborted takeoffs, made before reaching a properly computed unstick point, when no apparent difficulty existed.

There is, then, only one logical explanation. The pilots were not thoroughly familiar with the operating characteristics of the aircraft under the existing atmospheric conditions.

Most pilots have had occasion at one time or another to take off from high altitude airfields such as Denver, Cheyenne or Albuquerque. It is fairly certain that they have observed the difference in takeoff performance as compared to that at airfields of lower altitudes. Most pilots realize that these differences are related in some way to the density of the air, but few understand the underlying principles in detail.

In the past the relatively good takeoff performance of reciprocating engine aircraft overcame the air density problem, and runway lengths were adequate under all but the most extreme conditions. With the advent of jet aircraft, however, the picture has changed considerably.

No longer can the pilot leap into his aircraft and take off with complete disregard for field atmospheric conditions. He must understand the effects of air density on the performance of his plane and consider these conditions when planning his mission.

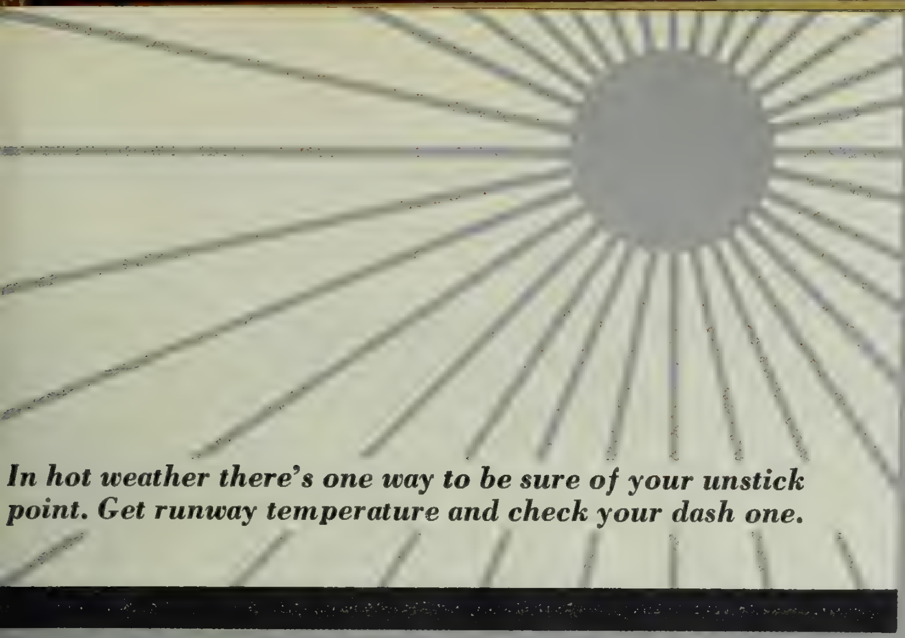
Although this problem is relatively new to the pilot, aircraft and engine designers have always considered air density in their calculations. The performance of both aircraft and engines is dependent upon the density of the air in which they are operating. That's just common sense.

Since the density of the air varies with atmospheric conditions, the performance of aircraft and engines can be analyzed objectively only if preliminary and test data are reduced to certain standard conditions. Basically, these standards as established by the NACA are:

- The pressure at mean sea level is 29.92 in. hg.
- The temperature at mean sea level is 59 degrees F. (15 degrees C.).
- The temperature drops at a constant rate of 3.56 degrees F. per 1000 feet throughout the lower atmosphere.

These standard conditions rarely exist however, and the density of the air varies with the temperature and barometric pressure. But these varying conditions can be corrected to standard and expressed as density altitude.

Density altitude is the altitude at which air of a given density exists in the standard atmosphere. If for example, the temperature at Denver, Colo., elevation 5500 feet, was 110 degrees and the altimeter setting (barometric pressure reduced to sea level) was 29.55, the air would be rarified to the extent that the density altitude would be approximately 10,000 feet. Under these conditions, an aircraft taking off would respond



***In hot weather there's one way to be sure of your unstick point. Get runway temperature and check your dash one.***

the same as if the actual runway was 10,000 feet above sea level under standard conditions.

Since the airspeed indicator operates on pitot pressure, which in turn is dependent on air density, the indicated takeoff and stalling speeds will remain the same for all density altitudes in the lower atmospheres. However, since the lift of an airfoil varies with the density of the air, the true speed or groundspeed required to produce sufficient lift for takeoff will increase as the density altitude becomes higher.

As an example, check this table:

| DENSITY ALTITUDE | STALLING AIRSPEED Indicated | STALLING AIRSPEED True |
|---|---|---|
| Sea Level | 90 mph | 90 mph |
| 10,000 feet | 90 mph | 105 mph |

The most noticeable effect of density altitude on aircraft performance is the ground roll required for takeoff. The thrust produced by a jet engine, like the lift of an airfoil, varies directly with the density of the air. Here, we must consider the mass flow of air through the engine. The mass decreases as the density decreases resulting in corresponding loss of thrust. Elementary, you say? Okay, so it is. But, apparently a few pilots have overlooked or forgotten some of the basic principles of jet propulsion.

Now, here is where we begin to get into a bind. This reduction of takeoff thrust coupled with the higher required true airspeed (takeoff groundspeed) results in sharply increased takeoff ground rolls for jet aircraft at high density altitudes. Let's examine the takeoff roll distance required for a jet fighter currently employed by the Air Force:

| DENSITY ALTITUDE | TAKEOFF GROUND ROLL |
|---|---|
| Sea Level | 3900 feet |
| 2000 feet | 4200 " |
| 4000 " | 4700 " |
| 6000 " | 5500 " |
| 8000 " | 6700 " |
| 10,000 " | 8100 " |

Aircraft performance under varying atmospheric conditions has been calculated and tabulated in the Flight Handbooks for convenient use. The problem is primarily that of insuring that a pilot considers these conditions during mission planning.

Although we didn't specifically mention it earlier, jet bomber aircraft were not involved in any of the accidents cited. This was not because the bomber is any less vulnerable to the exacting demands of density altitude problems, but rather that jet bomber pilots are required to calculate the takeoff performance for each flight as a part of their preflight planning. We feel this proves a point, too.

Since density altitude is a comparison of existing atmospheric conditions to standard conditions of pressure and temperature, density altitude can be computed by correcting the atmospheric pressure adjusted to standard pressure (29.92 in. hg.) for the existing temperature.

Humidity must be considered for exact calculations, but the effects are negligible from the pilot's standpoint, and this factor therefore is not included in this discussion.

A knowledge of density altitude is necessary in understanding the effectiveness of any given aircraft or power plant. However, the performance charts in the Flight Handbooks are based on pressure altitude plus temperature which determines air density but are read in terms of operating data instead of density altitude.

Now here's a little wrinkle that may stand you in good stead one of these fine, hot days. Pressure altitude may be determined by setting an altimeter to the NACA standard, 29.92 in. hg. and reading the altitude shown by the instrument. The temperature is available in any weather office, but here is a word of caution. Secure the runway temperature if possible rather than ambient. The difference is likely to be several degrees, at least.

With these two factors available, plus the known weight of the aircraft, the pilot can determine aircraft performance from the charts in the Handbook. When he wants to know where the old blowtorch will become unstuck, the pilot can go to the dash one for that answer.

By rule of thumb, an increase in temperature of 15 degrees F. or a decrease of 1 in. hg. in barometric pressure will raise the density altitude 1000 feet. A 1000-foot increase in density altitude can result in over 10 per cent increase in takeoff roll requirements.

Pressure variations of 1 in. hg. are rare; however, it is not uncommon for the temperature of the air near the surface of the runway to be as much as 10 degrees F. above the air temperature recorded at the station.

Since aircraft performance is dependent upon actual density of the air in which it operates, the runway air temperature must be provided for the pilot so takeoff performance can be determined accurately.

The Air Weather Service has recognized the importance of this condition and published a letter (No. 55-33, dated 6 Aug 52), directing weather personnel to offer runway temperature observations to base commanders for the pilots' benefit.

So, in the final analysis, it all boils down to this: Accidents resulting from ignorance of aircraft performance under varying atmospheric conditions are inexcusable. All necessary information and data are available to pilots and operating personnel. Just crack a dash one. You'll find the info you need there.

Don't let old Sol catch you with your guard down. Remember, the hotter the temperature the shorter the runway! ●

**A preview of things to come in navigation. Automatic devices will relieve pilots from the ever-increasing burden of traffic control.**

# the Automatic way

**John E. Sommers**
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**Staff Engineer**
**The Air Navigation Development Board**

IN this age of flight which lies somewhat beyond the half-way mark between "seat of the pants" flying and fully automatic flight, the trend is toward high speed, high performance aircraft, increased complexity in the cockpit and growing congestion of the airways. These factors are placing an ever increasing burden on the pilot as well as the traffic controller. However, there is much evidence that automatic navigation devices can bring some relief to both.

At this point we should define both "automatic navigation" and the "common system." A search reveals no appropriate definition for "automatic navigation," so the following will be used for the purposes of this article. "Automatic navigation is the automatic process of obtaining position information and converting it to steering information." The principal difference between this and automatic flight is that the pilot retains manual control of the aircraft and actuates the controls in accordance with the steering information.

The "common system" is a national system of air navigation and traffic control which serves the common needs of civilian and non-tactical military aviation, but which is capable of useful integration with any air defense system set up by the national military establishment. The responsibility for the development of the common system is vested in The Air Navigation Development Board (ANDB), which was created by charter agreement between the Secretaries of Defense and Commerce in 1948. This charter agreement has recently been revised and reaffirmed to accelerate the program and increase its effectiveness. The principal navigation facilities of the present common system are the omni-directional range (VOR), the distance measuring equipment (DME), the instrument landing system (ILS) and the precision approach radar (PAR). For traffic control, these facilities are supplemented by airport surveillance radar (ASR), VHF/DF and various communication facilities.

Until 1929, air navigation was accomplished primarily by visual reference to the ground, including the use of beacon lights, and by dead reckoning.

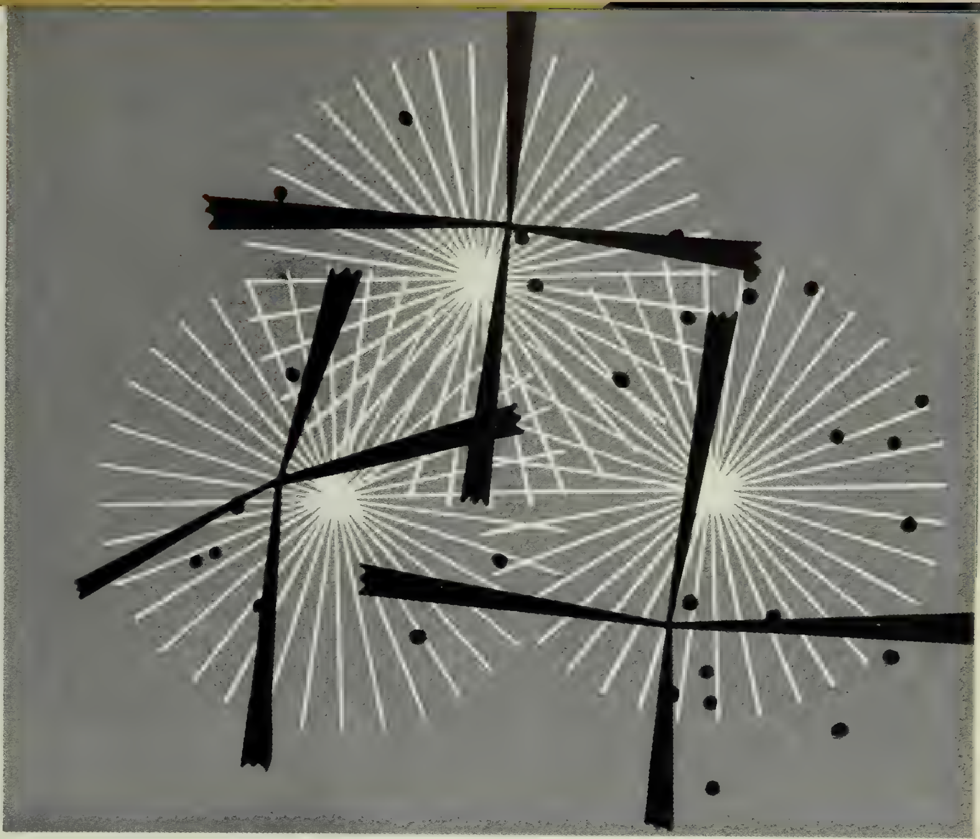
Development and implementation of the low-frequency navigation aids such as the low-frequency/medium-frequency four-course range, and the non-directional radio beacon provided the first well-defined radio navigation routes and introduced a new era in the age of flight. Most of this system is still with us today and is being actively used for navigation and traffic control. However, this system with its limitations of heavy static, course swinging, limitation on the number of courses and lack of distance information is already inadequate and is gradually being phased out. It is being replaced by a polar coordinate system, often referred to as the RHO-THETA system. In this system RHO is the distance from the station obtained from the distance measuring equipment, and THETA is the magnetic bearing obtained from the omni-directional range. In contrast to the four separate courses provided by the low-frequency range, such a system provides continuous fixing information and lends itself to the use of automatic navigation devices.

The common system program is still young and much navigation is still done on low-frequency facilities. There is little question that, within a very few years, azimuth and distance position information, supplied by VOR/DME and TACAN, or some other system, will be available in virtually all of the airspace above the United States.

The use of such a system, especially with automatic navigation devices and aided by radar and the common system ILS, will ease traffic control. It will provide more precise navigation, greater flexibility of routes, and will improve possible hazardous situations by taking much of the burden of navigation from the pilot.

Figure 1 illustrates the increase in utility which can be achieved by replacing three low-frequency range

Fig. 1. RHO-THETA facilities provide a means of establishing multi-lane airways.



facilities with three RHO-THETA facilities when users are equipped to take advantage of the continuous fixing information. It will be noted that there are 35 airports within a coverage area of these facilities. However, as the four-course range provides a position fix only when the aircraft is directly over the station, at the intersection of two range legs or where a VHF marker is located on a range leg, it readily can be seen that the low-frequency ranges in this area serve only a few airports (at best about four each). However, the RHO-THETA facilities properly sited will permit position fixes at any point within the area, thereby serving all airports. They also provide a means of establishing multi-lane airways rather than the single lanes provided by the four-course range.

There are at least three different degrees of flexibility which can be achieved in flying the present common system depending upon the manner in which the aircraft is equipped.

Referring to Figure 2, let us consider various means of going from point *A*, which is in the coverage of VOR *B*, to point *C*, which is in the coverage of VOR *B″*, via *A* course which passes through the coverage of VOR *B′*. An aircraft equipped with a single VOR receiver can proceed from *A* to *C* by tuning his VOR receiver successively to VORs *B*, *B′* and *B″*, and flying radials *AB*, *BD*, *DB′*, *B′D′*, *DB″* and *B″C*.

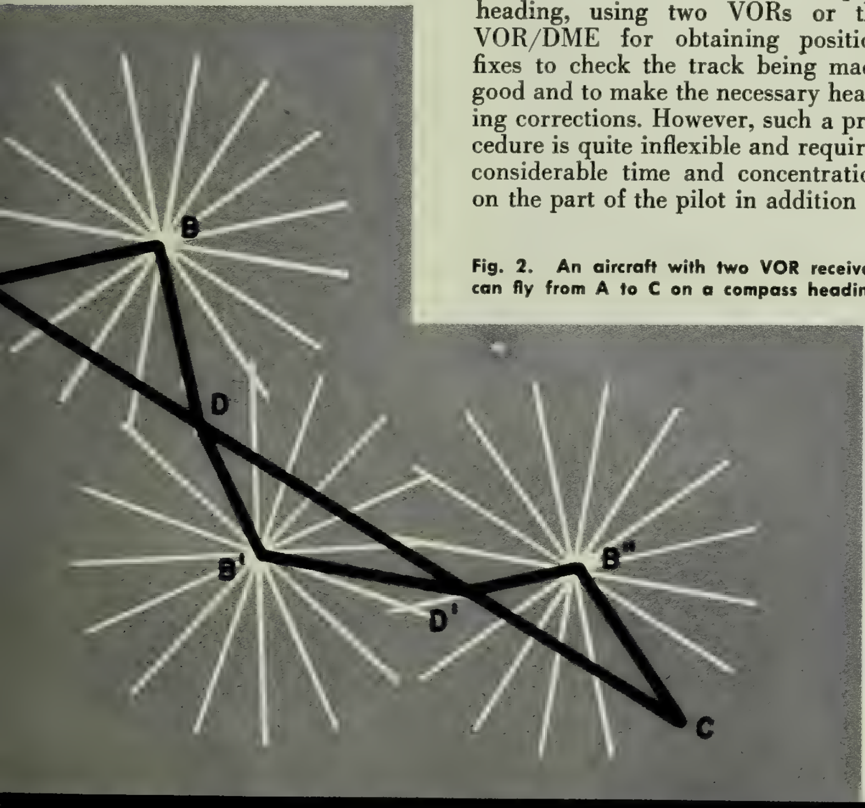


Fig. 2. An aircraft with two VOR receivers can fly from A to C on a compass heading.

Having selected the VOR station and the radial which he desires to fly, the pilot then has only to fly in accordance with the right-left steering indications provided by the cross-pointer instrument. If, however, his aircraft is equipped with two VOR receivers, the second receiver can be tuned to station *B′* while he is flying radial *BD* and provide a smoother execution of the transition from radial *BD* to *DB′*.

As a matter of fact with two VOR receivers or one VOR and one DME receiver, it would be possible to fly direct from *A* to *C* on a compass heading, using two VORs or the VOR/DME for obtaining position fixes to check the track being made good and to make the necessary heading corrections. However, such a procedure is quite inflexible and requires considerable time and concentration on the part of the pilot in addition to considerable preflight planning. The so-called course line computer automatically solves this problem. In effect, it enables a pilot to establish a VOR/DME combination at his point of destination, and thus fly directly to it as though it were actually the location of the VOR/DME.

Thus in flying from *A* to *C* he would first establish the station at *D*, then *D′*, and then at *C*. He would then fly this course manually by reference to the cross-pointer instrument which would provide right-left steering information with regard to his desired course plus distance information to the destination. He could also fly this automatically by the use of the autopilot couplers which are gradually becoming available. There are two types of course line computers: one of which computes the desired course from the outputs of two VOR receivers, and another type which computes the desired course from the combined VOR/DME information. This development represents a definite step forward in extending the usefulness of the RHO-THETA system. But its use still requires the pilot to make reference to a map to translate his coordinates into his position, relative to natural and man-made obstructions.

Flying a complicated flight pattern with this equipment requires the pilot frequently to change input settings to the computer, and in addition re-

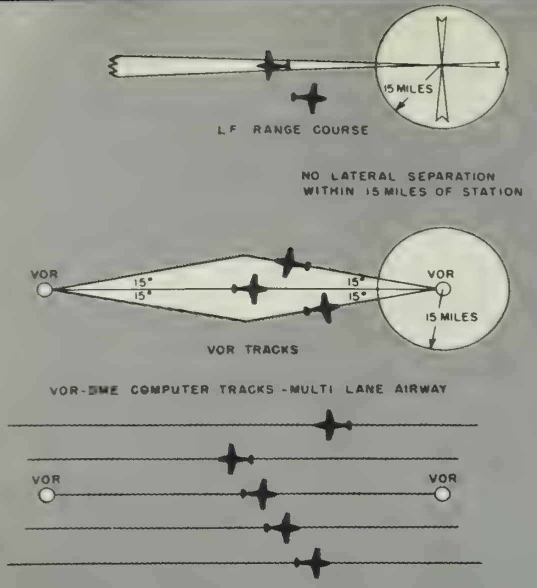

15 MILES
L F RANGE COURSE
NO LATERAL SEPARATION WITHIN 15 MILES OF STATION
VOR
15°
15°
15°
15°
VOR
15 MILES
VOR TRACKS
VOR-DME COMPUTER TRACKS - MULTI LANE AIRWAY
VOR
VOR

Fig. 3. Pictorial computer, VOR/DME add airways capacity.

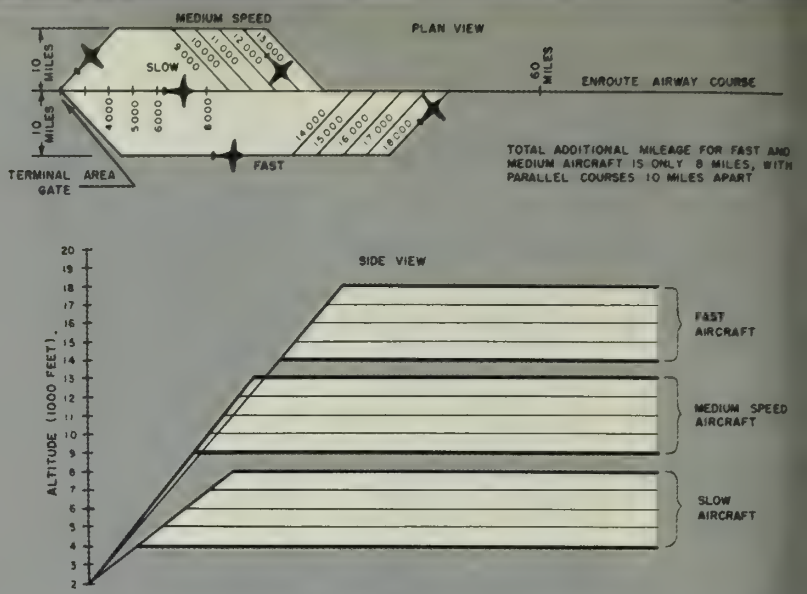


Fig. 4. Multiple tracks used for different speed aircraft to climb to cruising altitude.

quires considerable detailed preflight planning. Furthermore, the addition of the course line computer adds cockpit complexity and increases rather than decreases the number of things the pilot has to do and watch. Hence, in order to overcome these shortcomings, to simplify the cockpit instrumentation and to present the pilot with a picture of his aircraft moving across a map of the terrain, the Air Navigation Development Board sponsored the development of the pictorial computer. At the risk of seeming to belabor the obvious, it should be emphasized that psychologists and human engineering experts agree that this type of display provides navigation information in the form from which it can be assimilated most readily by the pilot.

The pictorial computer presents the pilot with a map of the area over which he is flying and an indication of where he is on this map at all times. This gives him a pictorial view of his progress along any path he selects, as well as his relation to obstructions or danger areas. In addition, it provides an almost unlimited number of flight configurations and routes. This device takes much of the burden of navigation from the pilot and, it is believed, achieves a greater degree of security by constantly showing him his position with respect to obstructions and by relieving some of the tension which usually accompanies instrument flight.

Three different pictorial computers were developed for ANDB by Aero Electronics, Sperry Gyroscope Corporation, and The Arma Corporation, respectively. The scope of this article will not permit a detailed discussion of the characteristics and evaluation results of the three types of pictorial computers. However, *Flying Safety* proposes to go into these systems in considerable detail at a later date.

Having pointed up some of the advantages to the pilot, let us look at what these devices have to offer for solving some of the air traffic control problems in the en route portion of a flight. For the purposes of this discussion, the en route area will be that portion of the airway system which lies outside of the immediate vicinity of the air terminal. Nevertheless, it includes many of the problems generated by the existence of the terminal area such as those associated with climbing and descending aircraft to and from cruising altitudes for departure from or entry to an airport. In the en route traffic control area there are three particularly troublesome problems which are closely related to the precision and flexibility of the navigation system in use.

The first is the overtake problem or those problems associated with aircraft going in the same direction and along the same airway. Obviously, if all aircraft going in the same direction were of the same speed and climb performance, it would only be necessary to start them out at given intervals. However, differences in performance create problems.

The second is the altitude change problem. This type of problem has several phases. One is the opposite direction phase wherein it is desired for an aircraft to climb or descend on an airway where there is traffic coming from the opposite direction. Normally, opposite direction traffic is assigned to alternate cruising altitude levels. However, the problem develops in transition areas where an aircraft is climbing out of a terminal area to a cruising altitude or descending to a terminal area from a cruising altitude. Sometimes it becomes necessary to make an altitude change due to weather conditions, terrain features or operating considerations for best fuel economy.

This problem is becoming more troublesome with modern pressurized high-altitude aircraft which frequently traverse as much as 75 miles in climbing out to cruising altitude. Similarly, descent from cruising altitudes may be started more than 100 miles from destination. These distances will be extended even further when jet aircraft enter the commercial air carrier field. Present information indicates that jet transport aircraft may traverse more than 200 miles during climbs and descents.

The third problem has to do with crossing courses. This problem is associated with aircraft on different airways that are crossing or converging at the same cruising altitude. When either or both aircraft are changing altitude through levels already in use at the intersection in-

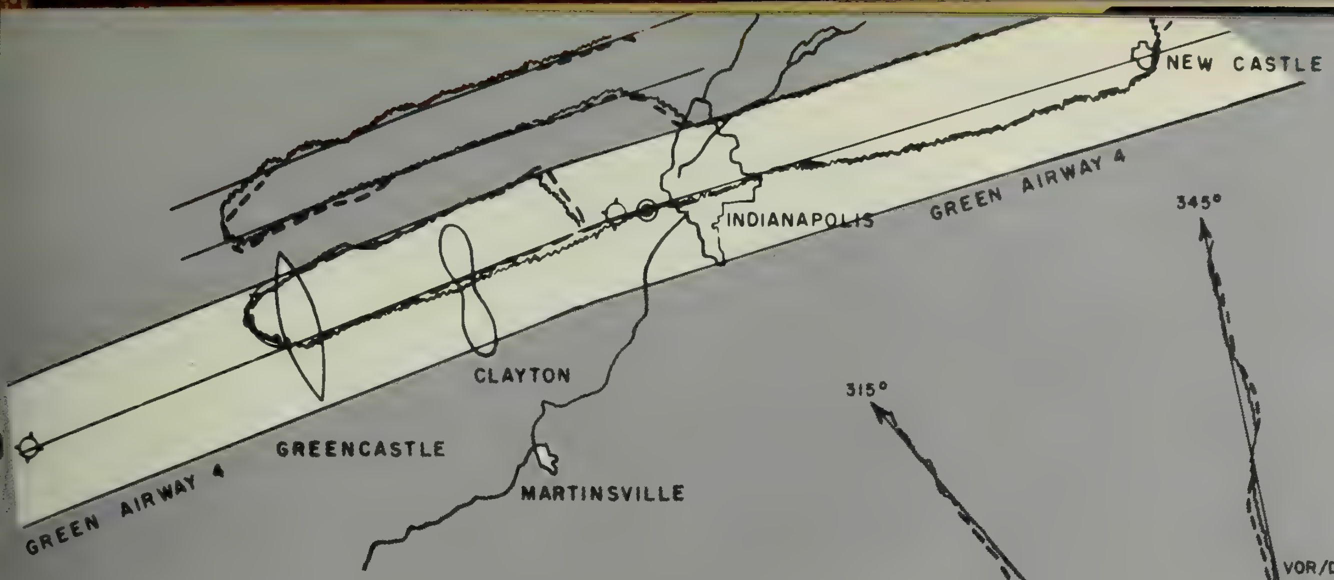


Fig. 5. A pictorial computer flight made on a multi-lane airway with five mile separation.

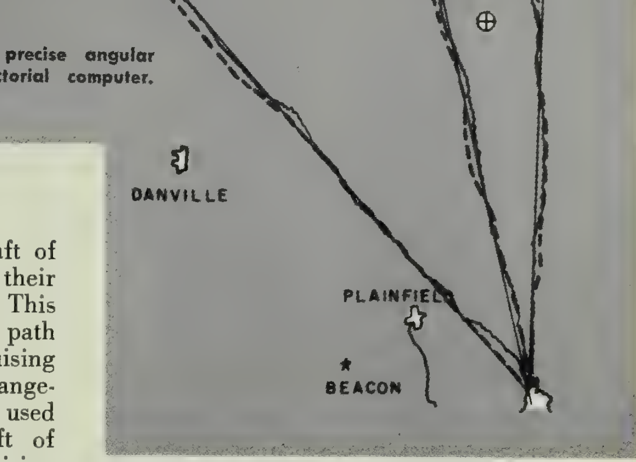


Fig. 6. Aircraft can fly precise angular departure tracks using pictorial computer.

volved, the problem becomes acute.

The solution to all these problems lies in providing additional parallel lanes at the same altitude so that aircraft can climb through or descend with sufficient lateral separation through an altitude which is already occupied. For want of this capability in the present system, aircraft must be delayed in climbing and descending, or vectored off on detour courses in order to bypass such situations.

Figure 3 illustrates how the pictorial computer and VOR/DME can increase the capacity of an airway. On the low-frequency range courses, it is possible on certain ranges, where courses are good, to use what is known as "right side separation" at distances beyond 15 miles from the station. This means that in the case of an airplane ascending to or descending from a cruising altitude, separation would be obtained by having the pilot fly well to the right of the course. This can only be used where courses are good, and at sufficient distances from the station to insure a course width adequate to provide the necessary separation. Figure 3 also shows the use of the VOR with 15 degrees separation to provide right side separation in both directions. With VOR/DME and pictorial computers, it should eventually be possible to use high-capacity airways having a number of parallel lanes, and separated perhaps by as little as 10 miles.

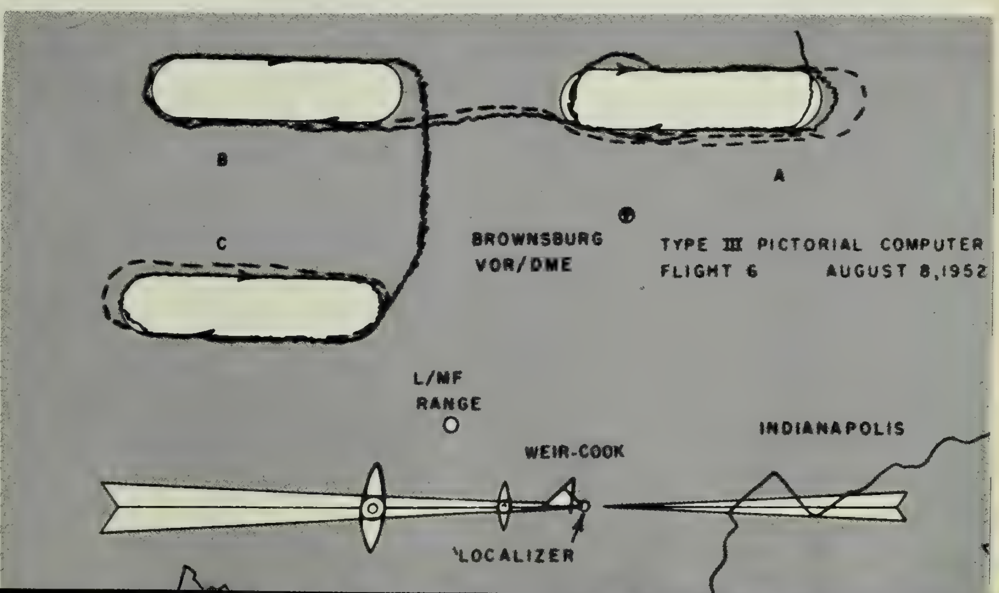
Figure 4 shows how the capabilities of the pictorial display and computer might be used to permit aircraft of different speeds to climb out to their cruising altitudes without delay. This is accomplished by providing path segregation according to the cruising altitude desired. A similar arrangement of multiple lanes could be used to expedite descent of aircraft of different characteristics from cruising altitude to the terminal area. With this arrangement, high-altitude, high-performance aircraft overtaking slower aircraft operating at the lower altitudes would not be penalized and forced to wait until a slower aircraft landed.

Similarly, at en route or cruising altitudes, pictorial displays would permit the use of multiple lanes for change of altitude or for a passing course around another aircraft at the same altitude.

Let us look at some results of flight evaluations of pictorial computers showing the precision with which a desired path may be realized in actual operation.

Figure 5 is a record of a pictorial computer flight demonstrating a multiple lane airway with approximately five miles separation at distances out to 50 miles from the station. These tracks were flown with the type III pictorial computer, which is a lap computer. But they are representative of the results achievable with any of

Fig. 7. Continuous position information and the pictorial display help simplify holding patterns.



the development models. Solid lines show the desired track, dashed lines the actual track and the jagged line the computer track. Precise departure tracks which will help the terminal area controller segregate outgoing traffic can also be achieved with a pictorial computer.

Figure 6 records a demonstration of how precise such courses can be flown with the pictorial computer. The flight recorded in Figure 7 shows the proficiency with which holding patterns may be executed with continuous position information and the pictorial display.

Laboratory tests have shown that the maximum average errors (the greatest error occurring in the average results of repeated tests for a given point of the display) in bearing and distance do not exceed .2 of a degree or a half mile, respectively. Controlled flight tests conducted as a part of the technical evaluation revealed a maximum system error in position of 1.3 nautical miles when a display was used within 15 nautical miles of an omni-bearing station.

The major portion of the system error lies in the bearing information derived from the omni-directional range. Because this error is in azimuth, it introduces position errors which are proportional to the distance from the station; hence, parallel airways separated 10 miles are not now feasible much more than 30 miles from the omni-bearing station. However, recent improvements in antenna design have reduced ground station error substantially, and it is expected that development will further improve the accuracy of the bearing information available and thus increase the utility of the system.

The neck of the bottle in this problem of getting aircraft from the airway to the unloading ramp, is the final approach and landing phase. It is very important to achieve the maximum approach success. An aircraft emerging from the overcast may find itself in an attitude from which it cannot make a successful landing. This not only introduces delays in the system, but involves considerable increase in pilot problems due to the required changes in aircraft trim and power settings, as well as causing the low altitude maneuvering which must accompany the missed approach procedure.

It has been demonstrated conclusively that automatization of this phase of the navigation problem yields a large return in increased probability of a successful approach. Equipment called a flight director system shows great promise of improving the probability of a successful approach on the common system ILS. It can be defined as an analog computer that assimilates information relating to aircraft heading, attitude and displacement from a specific flight path, and computes those attitude changes necessary for the aircraft to attain and remain on that specific flight path.

The required attitude changes are presented to the pilot by meter movements indicating right or left bank, or up and down pitch changes. In this manner, a flight director system allows for a separation of the plan of flight from the mechanics of flight. The pilot sets the plan of flight into the equipment by setting in his desired heading and by tuning in the appropriate radio facility, in this case the ILS. The computing equipment measures how far the aircraft is from where the pilot wants it to be. It does not indicate what the error is but provides an indication of how the controls should be set in order to neutralize the error at a precalculated rate. This minimizes the requirement for the pilot to piece together bits of rate and displacement information from several instruments in order to accomplish an instrument maneuver. It makes it possible for a less experienced pilot to fly an ILS approach as accurately and precisely as more experienced pilots by providing a source of guidance or steering information that does not require a high order of proficiency to follow. The pilot simply has to perform the mechanics of flight by acting as a servo in banking the aircraft to center a steering needle. Errors in pitch are eliminated in a similar manner to those in yaw. Two examples of this type of equipment are the Sperry Zero Reader and the Collins Integrated Flight System.

Flight evaluation data were taken at Wright Field to compare the approach success of the flight director system with that of the E-6 automatic pilot and standard cross-pointer approaches. Data on approximately 23 approaches for each system show practically no difference in approach success between the flight director system and the automatic pilot.

However, both of these systems show approach successes which are very much better than those achieved with the standard cross-pointer instrumentation. These differences become more significant when it is pointed out that the manual approaches were flown by pilots who were very experienced in ILS flying, whereas the flight director approaches were flown by pilots with very little experience in making ILS approaches.

In 1947, the Air Force demonstrated fully automatic flight by equipping an airplane, taking it off from the United States, flying it to England and landing it, all automatically. However, fully automatic flight, especially for commercial passenger-carrying aircraft, is not just around the corner. On the other hand, there is every indication that automatic navigation devices such as flight director systems and pictorial computers will play an increasingly important role in helping to achieve a more effective and efficient air traffic control system, as well as lifting a lot of the burden of navigation from the pilot. Both the flight director system and the pictorial computer are natural waypoints in the development of fully automatic flight.

Furthermore, it appears that the accepted philosophy of having automatic devices in aircraft monitored by humans will perpetuate the pictorial display well into the age of fully automatic flight. Although the pictorial computer development is still in its infancy, one manufacturer of these devices is already considering a production run, and at least two major aircraft manufacturers are making provisions for the inclusion of this type equipment in their new designs.

The principal criticism leveled at the pictorial computer is the space requirement in the instrument panel for a 10-inch display. However, a properly designed pictorial computer should lead to cockpit simplification by eliminating the necessity for some other instruments presently included.

It seems reasonable to suppose that further developments and the inclusion of transistor techniques will permit some reduction in size. The Air Navigation Development Board in its broad program for research and development in the field of air navigation and traffic control will continue to take advantage of these new techniques. The Board will develop and evaluate improved devices such as the pictorial computer for improving the ease, flexibility and precision of instrument flight. ●

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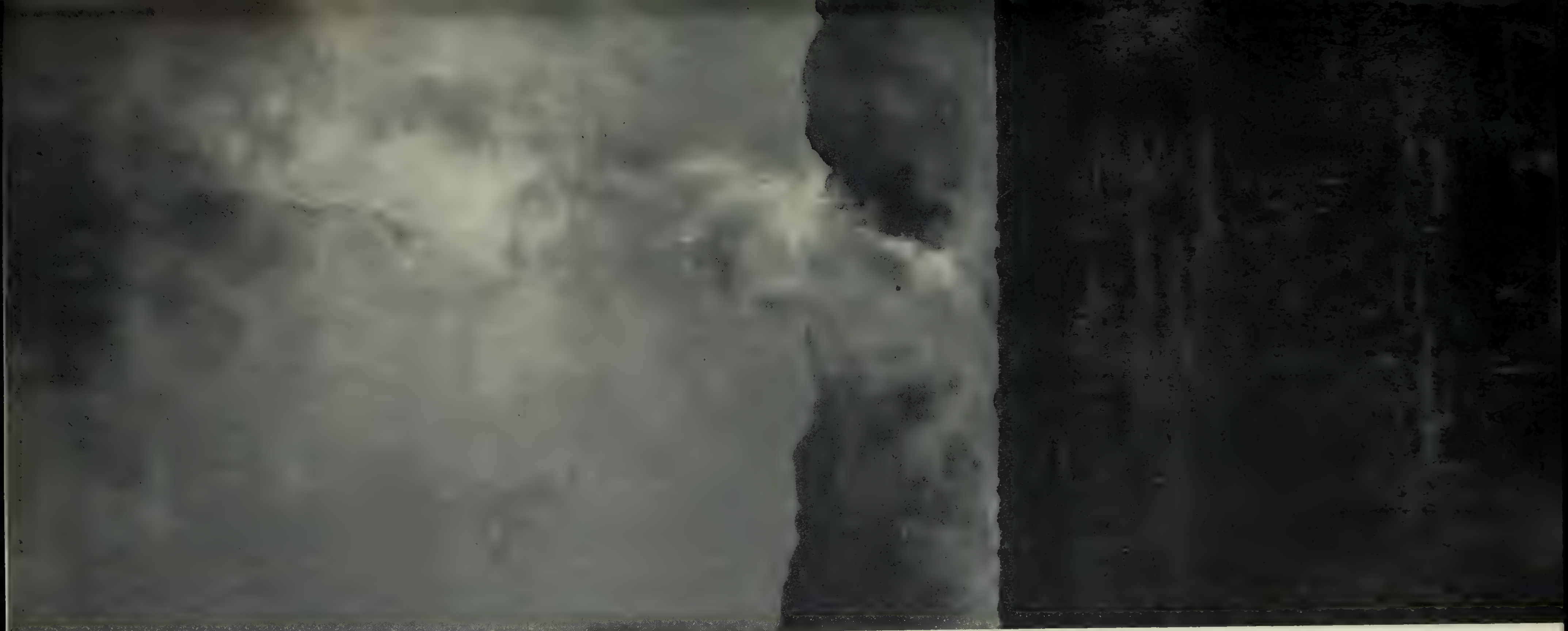

# Mal Function

Mal knew he was hot,
But runway was hotter.
Old jet wouldn't rise
The way that it ought-er.

Page two-two tells why
'Tis simple, you see.
The Hotter the Shorter —
Could happen to thee.

Your dash one has tables
Computed for heat.
Ground roll is all figured.
It just can't be beat.

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# FLYING SAFETY

UNITED STATES AIR FORCE

SEPTEMBER 1954

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UNIVERSITY OF ILLINOIS

Rocket Gunnery School . . . . . . . page 8

VOLUME TEN NUMBER NINE

# FLYING SAFETY

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USAF PERIODICAL 62-1

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**This month's cover illustrates that firepower plus is the keynote of the present-day interceptor. A hit by a single rocket is capable of knocking out the largest bomber ever built.**

# ★ FLYING SAFETY AWARDS ★

In recognition of exceptionally commendable accident prevention records, engraved bronze Flying Safety Plaques have been awarded to the nine organizations and installations listed below for the period January through June, 1954. These units have contributed to the increased economy and effectiveness of the Air Force by promoting outstanding accident prevention programs and achieving exemplary records.

Such achievement is marked every six months by award of the Flying Safety Plaque.

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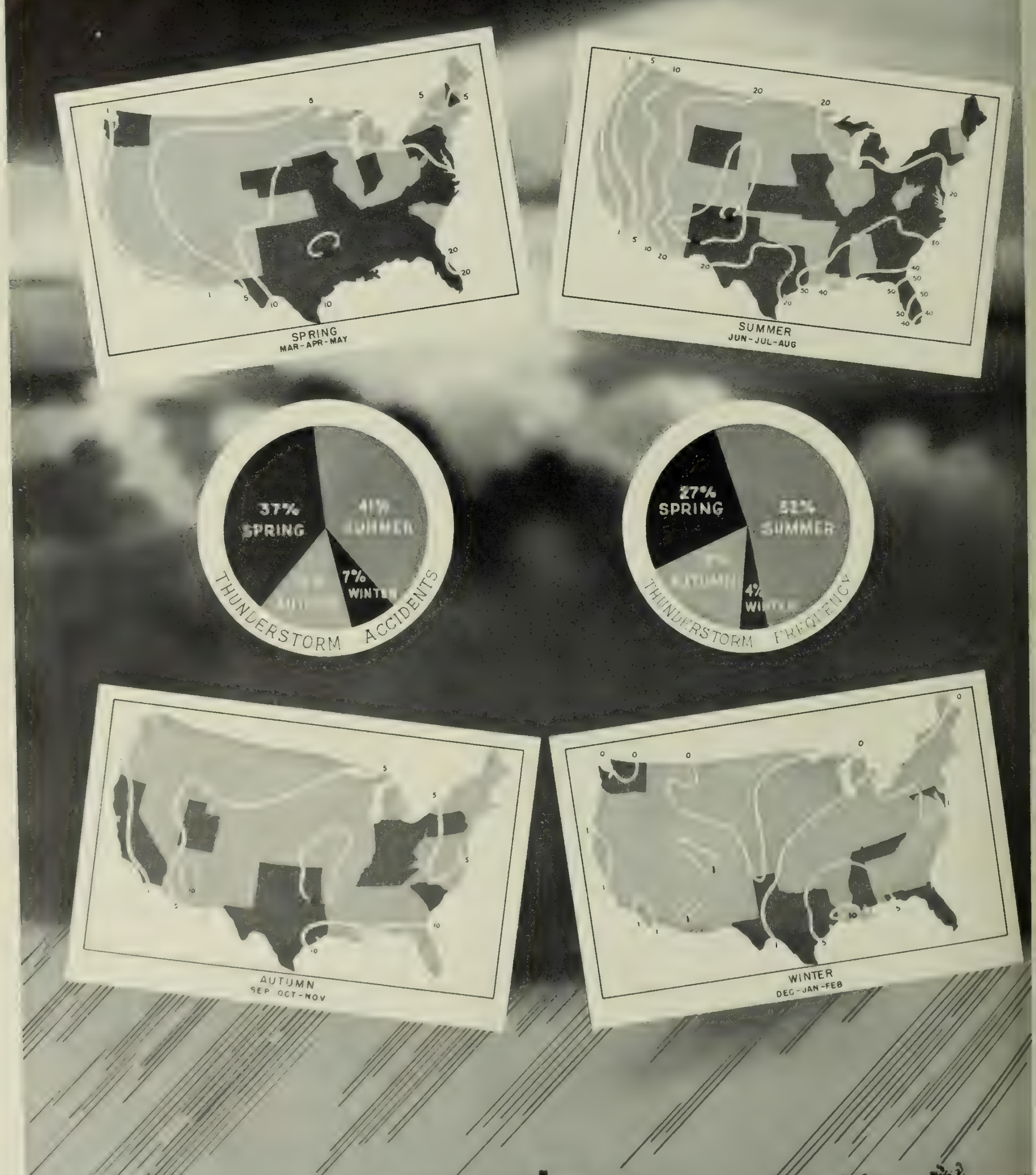
- **3800th AU Wg, Maxwell AFB (AU)**
- **318th F-I Sq, Thule AB (NEAC)**
- **119th F-B Sq, Newark Arpt. (ANG)**

# THUNDERSTORMS



**AWS has prepared an article covering all phases of thunderstorm development and related flying hazards for FLYING SAFETY. We believe this information will be of significant value to all pilots.**

THUNDERSTORMS are essentially shower clouds in which electrical discharges can be seen as lightning and heard as thunder by a person on the ground. They present a major hazard to flying because of the violent vertical motion of the air, with strong up-and-down movements in close proximity to each other.

In its process of development a thunderstorm appears to be a cumulus cloud gone wild. Lightning and thunder, usually gusty surface winds, heavy rain and occasionally hail accompany it. All these phenomena are indicative of complex processes going on within the cloud. Consequently, the problem of flying during thunderstorm conditions has been one of major concern ever since commercial and military aviation advanced to the point where flight activities are not confined to periods of good weather.

Recent research has determined that all thunderstorms are fundamentally similar both in structure and in the weather elements they contain. Structurally, the thunderstorm contains many centers of convective action which are called "thunderstorm cells." The largest storms contain many cells and cover an area ranging from approximately 20 square miles to more than 200 square miles. In many cases, the tops of well-developed cells extend well up into the stratosphere.

Each cell may develop more or less independently of those adjacent to it The evidence indicates that each cell passes through three different stages in its life cycle. The progression to succeeding stages depends upon the formation and fall of rain and the entrainment of the surrounding air into the cloud. That is, the air flowing in through the sides of the cloud and mixing with the updraft.

- The first or cumulus stage of development is characterized by updraft throughout the cell. During the initial stage, as the air becomes unstable, the atmosphere attempts to regain its balance and re-establish a stable condition. The greater the instability the more forceful is the overturning required to return the atmosphere to equilibrium, and increased amounts of cumulus and cumulonimbus are formed. A thunderstorm is a violent manifestation of this overturning in the atmosphere's struggle for stability.
- The second or mature stage is noted by the presence of both updrafts and downdrafts, at least in the lower half of the cell. Rainfall at the surface begins with and continues throughout the mature stage. The downdraft area increases in size until, in the lower levels, it extends over the entire storm cell. This is considered to be the end of the mature stage. During this stage the cell reaches its greatest height, which is normally about 40,000 feet, although an occasional cell extends higher than 60,000 feet, and many complete the life cycle without extending higher than 30,000 feet. The mean of the maximum heights reached by 199 Ohio thunderstorms, as indicated by radar, was 37,500 feet.
- The third and last, or dissipating stage, is indicated by weak downdrafts prevailing throughout the cell. Thunderstorm cells usually vary from one to five miles in diameter. The cells are usually in any stage of development, but the majority in a storm are either at the peak or dissipating stages.

Duration of Thunderstorm Cells

| *Stage* | *Duration* |
|---|---|
| Cumulus | 10-15 minutes |
| Mature | 15-30 minutes |
| Dissipating | 30 minutes |

Thunderstorm cells are the areas of greatest turbulence. As applied to thunderstorms, turbulence usually connotes a sequence of irregular vertical or horizontal motions of the air within the storm area. It is during the mature stage that turbulence reaches a maximum.

It is known now that the thunderstorm consists of a group of cells in which are concentrated the gustiness, drafts, hail and other weather elements that make flights near the storm extremely hazardous. Thus, it is necessary that the pilot be familiar with the thunderstorm, its attendant hazards, its geographic distribution and its relationship to past aircraft accidents. Based on observational data for a period of over 50 years throughout the United States and a valuable six-year study, "Analysis of Weather Elements as Cause Factors in USAF Aircraft Accidents 1947-1952," the maps and charts on the opposite page show the relationship between the frequency of aircraft accidents and the occurrence of thunderstorms. There is a direct variation of the frequency of thunderstorm days with the seasons.

The months of highest thunderstorm frequency are July and August, and those of lowest frequency are December and January. Aircraft thunderstorm accidents follow a similar seasonal pattern.

The mean number of thunderstorm days for each season is portrayed. States which are more darkly shaded represent those in which accidents occurred. Most thunderstorm aircraft accidents happened in the areas of the greatest mean number of thunderstorm days. The area having the greatest number of days per year with thunderstorms is central Florida. There are relatively high values (as well as a number of thunderstorm aircraft accidents) for the entire southeastern portion of the country, and an area of secondary maxima centered roughly over northeastern New Mexico and southcentral Colorado. The Pacific coastal regions have the least number of days during the year with thunderstorms.

Certain topographic features provide an ideal location for new thunderstorm development. Mountains or rugged relief of any kind, as contrasted with smooth terrain, are very favorable. Islands and peninsulas, as well as other heat sources, are conducive to the formation of afternoon storms.

Thunderstorms may occur individually, or in groups and masses that at times present an almost solid wall of convective clouds. Besides the usual difficulties of flight in clouds, the thunderstorm presents the additional unique difficulties of lightning, hail, heavy turbulence and frequent squall lines.

The squall line is usually described as a line of high winds, characteristically several hundred miles in length and usually of short duration. Throughout the eastern United States, the pre-cold front squall line is the predominant scene of thunderstorm activity, particularly from May through September. Generally, the thunderstorms associated with squall lines are little different from any others except for a tendency to be more severe, especially in producing effects at the surface, such as strong, gusty winds.

Records, however, show that turbulence is the most prevalent danger in thunderstorms and a very significant element in associated accidents. This hazard was especially prominent in accidents occurring in August, contributing greatly toward loss of aircraft control and unsatisfactory landings. The difficulties of maintaining proper flight attitude or airspeeds within highly turbulent clouds often lead to serious structural damage.

Turbulence is generally recognized under two broad categories — gusts and drafts, corresponding to two fairly distinct types of response experienced in an airplane. In a draft, the aircraft is displaced in altitude in one direction over several seconds of time because of the mean upward or downward motions of the air. Gusts subject the airplane to a series of sharp accelerations without a systematic change of altitude. These accelerations are caused by abrupt changes in velocity of the drafts and by small vortexes or whirling masses of air. The larger gusts are invariably associated with strong drafts.

Thunderstorm analysis shows that rain, as measured at the surface, is closely associated with the downdrafts. In the eastern and southern United States the average duration of thunderstorm rain at a given station is about 25 minutes, although it is highly variable from case to case. An airplane will frequently encounter high water concentrations in an area of updraft where the upward motion prevents any of the water from falling out of the storm.

Of more concern than rain in the determination of flight hazards associated with thunderstorms is the occurrence of icing. Research aircraft have encountered ice at the 20,000-foot level. The levels near and slightly above the freezing level seem to contain the maximum concentrations of heavy icing, hail, turbulence and the majority of lightning strikes. A review of the six-year accident summary indicates that hail damage was very apparent during spring and summer thunderstorm accidents.

Let's face it, "old anvil head" will always be with us. Knowing his associated hazards will help keep you out of trouble. ●

**Thunderstorms in the dissipating stage are easily identified by an anvil-like head. Weak downdrafts prevail throughout the cell.**

This article, reprinted from COMBAT CREW, explains the relationship between flying speed and gusts during penetrations.

# THUNDERSTORM FLYING

**J. W. Johnson, Convair Project Structures Engineer**

A PILOT or flight crew forced to fly in or through a thunderstorm may logically question the ability of the aircraft's structure to withstand the loads imposed by flight through a disturbed atmosphere. It is not impossible for structural failure of a major nature to occur under extremely turbulent conditions.

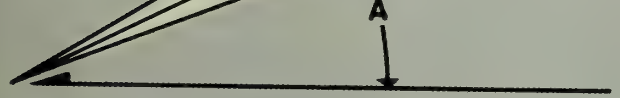
The aircraft designer considers this type of flight operation in the structural design. Normally one of the more severe design conditions is either gust at high speed or the so-called "light weight bump" condition. These specific design conditions are based on data obtained from recording instruments installed in commercial and military aircraft engaged in routine flights, together with data obtained from deliberate flights into turbulent areas undertaken to seek out the most severe conditions. These data are studied, and the result is the most logical gust intensity usable for design. Military aircraft of conventional type are usually designed to a *50k* effective gust. The expression *50k* gust is defined as a 50-foot-per-second gust acting with an efficiency *k* on the airplane. The value *k* is usually about 0.6; thus a 50 fps (feet-per-second) gust is an effective gust of 30 fps.

What happens to an aircraft encountering such air? Pictured is an airfoil section with the angle it makes with the relative wind denoted by the letter *A* (see Fig. 1).

The total lift coefficient on the section is $C_L1$, often expressed as the unit *m* per degree of angle of attack. The lift coefficient is then equal to *m* x *A*. Lifting force is expressed as $L = C_LDSV^2$ where:

L=lifting force in pounds
D=density of air
S=wing area in square feet
V=indicated speed in mph

FIGURE I



Equilibrium will be maintained if the lifting force equals the weight of the airplane. Therefore, the angle of attack can be determined since other values in the above expression are known.

The next diagram shows the effect of an up-acting gust of intensity 50k, on a wing moving at a forward velocity V. The change in angle of attack, ${}_{\Delta}A$, for the section resulting from gust is 50k/V expressed in radians (see Fig. 3). The added lifting force resulting from the gust is:

${}^{\Delta}L = {}_{\Delta}C_LDSV^2$ (Equation 1)

Angle of attack due to gust varies inversely with aircraft speed and directly with the gust intensity; and lifting force varies with the square of the speed, so a simple expression for lifting force due to gust will be:

${}_{\Delta}L = 5kmVS$ (Equation 2)

The load factor, ${}_{\Delta}n$, due to the gust effect may be obtained by dividing through equation 2 by the aircraft weight, W, then:

${}_{\Delta}n, = 5kmVS/W$ (Equation 3)

A better understanding of the gust effect may be obtained by following through a practical example. Given the following data:

W=airplane weight...250,000 lbs.
S =wing area........5,000 sq. ft.
V=indicated airspeed....200 mph
m=$C_L$ per degree............0.1
k =effective gust factor........0.6
D=air density..........0.002558

Substituting these values into equation 3 yields a value ${}_{\Delta}n = 1.20$ (approx.). Addition of the normal 1G load factor results in a design factor of 2.20. Stress in the structure in-

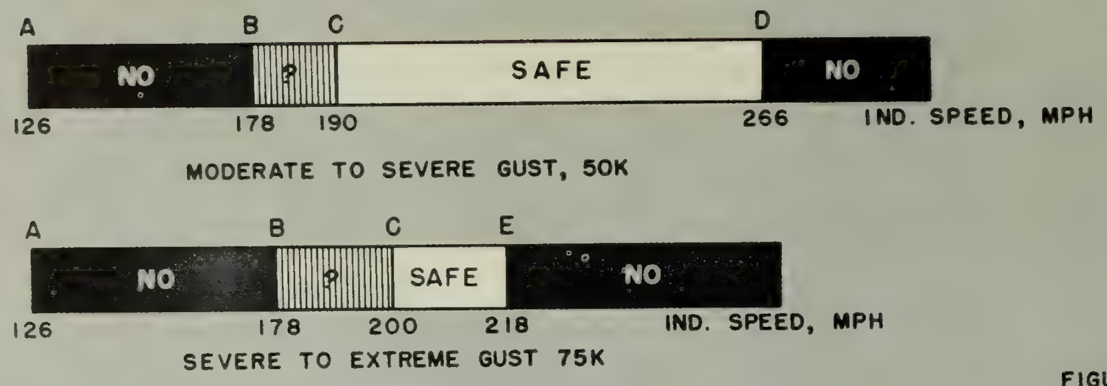


FIGURE 2

creases with factor; thus the most critical condition will be found when variables in equation 3 result in the highest factor. A check at a particular gross weight will prove most critical for wing structure when wing fuel is at a minimum. The fuel provides a relieving shear and moment since it is opposite in direction to that of air load. Assume in the above example that a 1G loading produces 30 units of bending moment and structural failure occurs at 84 units. The result is an allowable factor of 2.80 or an allowable gust increment $\Delta n$ of 2.80 — 1.00 or 1.80. Reference to equation 3 above, other values remaining constant gives an allowable speed in excess of 300 mph. The optimum structural speed will be the lowest consistent with other contingencies since this will maintain stresses at low level.

The minimum speed at which an airplane can maintain level flight is known as the 1G stall speed. Flying into a turbulent area will increase the stall speed since the incremental load factor resulting from the gust will require increased speed.

Typical speed limitations are shown above for an aircraft weighing 280,000 pounds at an altitude of 30,000 feet (see Fig. 2).

A—1G stall speed
B—normal cruising speed
C—stall speed at gust intensity
D—high speed limitations
E—structural limitations due to gust.

Speed limitations imposed by stall-out due to gust are not considered too serious by most authorities. The gust acts for a relatively short period of time, so the aircraft will recover before a serious stall will develop. The purpose of this article is to acquaint the pilot with limitations which exist. The minimum safe flying speed should be no less than cruise. Another possibility for penetration speed usable on B-36 models is 1G stall plus 70 mph which will, in some cases, result in an increase above cruising speed.

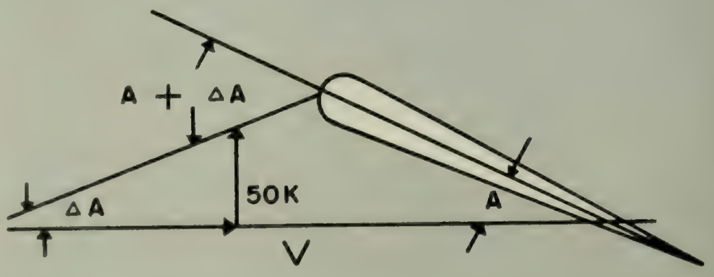
The bulk of the discussion has been directed toward gust effect on the wing. Similar effects will exist on other portions of the aircraft, particularly the fuselage and tail sections. A 1G balance plus gust is often the design condition for the horizontal tail and aft fuselage. In this case, the gust is assumed to act only on the horizontal tail. Major weight items are usually designed by the gust factor at minimum flying weight and maximum speed.

Gust intensities may be divided into three classifications; namely, 1. light to moderate 25k, 15 fps effective; 2. moderate to severe 50k, 30 fps effective; 3. severe to extreme 75k, 45 fps effective.

Data compiled over a considerable period of time shows the probability of encountering gusts of these magnitudes are: (1) 1 in 5000; (2) 1 in 1,000,000; (3) 1 in 50,000,000. This data is based on average conditions and may change appreciably in some areas, as witness the effect of the jet stream on flying conditions in the Korean theater of operations. The most intense gust measured to the writer's knowledge is in the order of 100 feet per second, or an effective velocity of 55 feet per second.

Basic rules to follow prior to entering a turbulent area are: Set power and pitch and maintain these settings through the disturbed area; disregard indicated speed readings since they may vary greatly in the turbulent area of flight. ●

FIGURE 3



# WELL DONE

## Capt. Robert B. Weinard

**469th FIS, 516 AD Gp**

**McGhee-Tyson Arpt, Tenn.**

CAPTAIN Weinard was leader of a flight of two F-86As that scrambled at Eglin AFB to intercept five B-47s. After orbiting at 42,000 feet for approximately 15 minutes, Captain Weinard started a left turn. However, the control stick was frozen and he found it was impossible to move the ailerons. He checked the aileron boost and hydraulic pressure, thinking the boost had failed, but all pressure indications were normal.

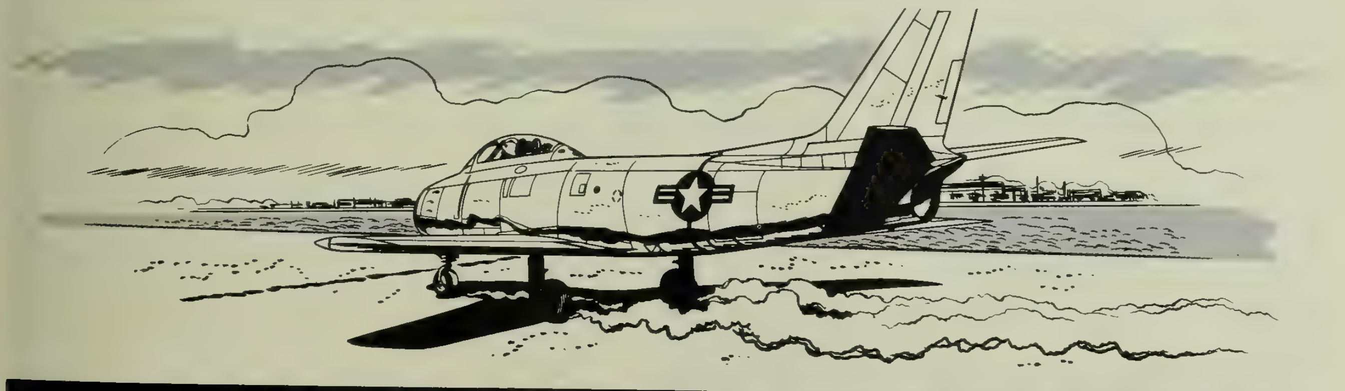
Capt. Weinard then slowed the aircraft down and managed to turn the plane by using rudder control. Full trim had no effect on the ailerons and the aircraft was flown back to Eglin at slow speed, using rudder to keep the wings level.

With the field in sight, a shallow descending turn was started. At 12,000 feet gear and flaps were lowered and tower approval was received for landing. The base leg extended over the Gulf and considerable turbulence was encountered crossing from sea to land.

While Capt. Weinard was attempting to maintain a level attitude, using rudder only, the F-86 often yawed up to 30 degrees. On several occasions the plane went into steep vertical slips and appeared to be completely out of control, but each time he was able to bring the aircraft back to level flight.

A round-out was completed over the end of the runway and the aircraft touched down, left wing low, approximately 15 degrees across the runway.

Capt. Weinard, through his outstanding skill and technique, regained control and completed the landing without damage to the aircraft. ●



# Talley Ho—and SPLASH

***ADC pilots are learning the latest techniques in rocket gunnery firing at the recently established Yuma AFB interceptor school.***

DOWN YUMA way, they're training a new breed of cats, nowadays. This feline prototype is still a fighter pilot, so it follows that he is a Tiger, but the Tiger is changing his stripes. In many respects he might well be called a technical Tiger. Technical because he must make intercepts in all kinds of weather; because he will be guided to his target by a man on the ground; because probably he will never see his target except as a blip on a radar screen, and because when he does "lock on," a computing machine actually will fire his rockets automatically at just the precise instant needed to intercept the target.

The Air Defense Command established the rocket gunnery school at Yuma AFB to teach pilots the latest techniques in rocket firing and to weld the interceptor crew (either pilot and radar observer or just the pilot in single seat interceptors) and the GCI controller team into a smooth-working unit. The success of the training is evidenced by the scores shot at the air-to-air rocket meet held in June of this year.

There are two separate but integrated primary mission units at Yuma: the 4750th Air Defense Sq. (Weapons) charged with training the TDY organizations in rocketry and intercept techniques; and the 4750th Tow Target Sq., charged with all of the tow missions.

The GCI training unit at Yuma, which is part of the 4750th Squadron, has a two-fold mission. Primarily, it provides proficiency training for ADC controllers and secondarily, it furnishes GCI control for the ADC interceptor squadrons training for weapons qualification.

Each unit, upon reporting in to Yuma, has a liaison officer assigned to it from the training squadron. His job is to work closely with the visiting unit, conduct initial briefings on Phases I, II and III and facilitate the program so that a maximum of training may be accomplished in a minimum of time.

In the flying training program, Phase I is devoted to acquainting pilots with procedures and in upgrading the interceptor pilots for the actual firing sorties of Phase III. All crews arriving at Yuma with less than 40 hours time in their aircraft or less than 40 aerial intercepts will be required to engage in Phase I training. Upgrading to Phase II is based on each individual's ability to learn.

In Phase I, T-33s, flown by qualified instructors, are used to simulate targets. Normally, target altitude is 25,000 feet unless visibility is restricted due to weather. The target is flown at 180 knots IAS and the interceptors at 280 knots IAS. All missions require two-way radio communications, with the operational channel and the alternate channel being assigned at the time of the mission briefing. IFF is used on all missions.

Intercepts are broken off any time visual contact is not established at a minimum of four miles. There is no established altitude separation between target and interceptor in Phase I work. It is the responsibility of both pilots to maintain sufficient clearance at all times. Regardless of whether or not the mission is completed, all aircraft must depart the Phase I area when a minimum of 1500 pounds of fuel remains.

### Phase II Training

In Phase II, intercepts are made on two T-33s, flying approximately 5000 feet apart to simulate the tow aircraft and target used in the last stage of training. Three interceptors per target are used to insure that pilots and controllers will become proficient in close control work with multiple fighters.

At the gunnery school, arming and de-arming areas are under the supervision of designated NCOs.

Once again, all missions are under GCI control, with a minimum of five successful intercepts per pilot flown. These five intercepts are recorded by direct scope cameras and are assessed by qualified instructors.

The lead, target and interceptor aircraft are flown at 20,000 feet. In the event the intercept is too close, and evasive action becomes necessary, such action will be taken only by the target aircraft. This added precaution eliminates any possibility of a collision occurring. With two miles to go, the target aircraft makes a check as to the position of the interceptor, and if contact is not made visually, the intercept is broken off. Initial airspeeds are 200 knots IAS for the target and 300 knots IAS for the interceptor. When possible, these airspeeds are increased the last three days of Phase II to call attention to train angle changes as they are related to airspeed changes. Critiques are held after each mission to explain mistakes and improper procedures and to analyze the techniques used by the interceptor teams.

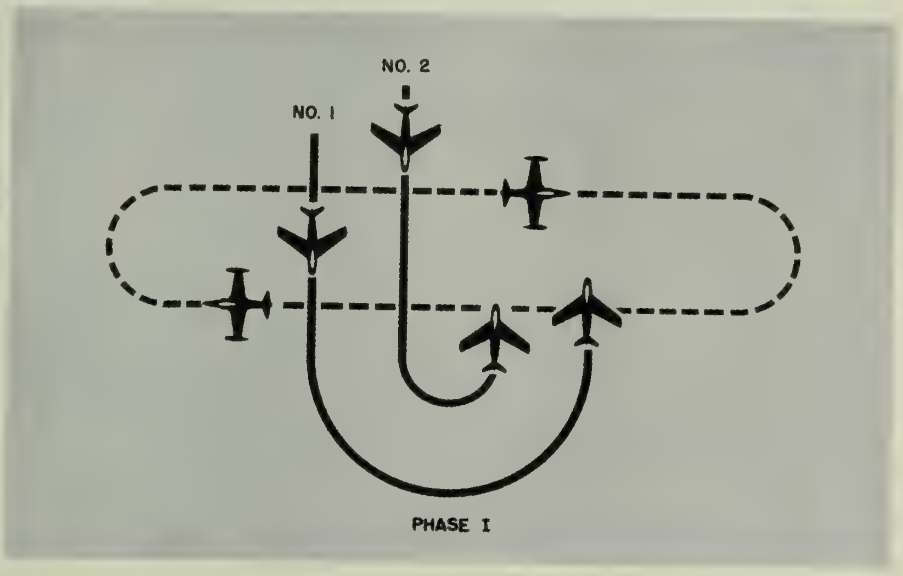
## Phase III Firing

The missions flown during Phase III are flown at different altitudes and airspeeds to focus attention on the different target-interceptor speed ratios. To get maximum target utilization, six fighters fire at each target, with three aircraft in the pattern at a time. All firing is accomplished on a towed target equipped with two spinning reflectors used to get better radar returns.

A standard cockpit procedure is used during Phase III when aircraft are armed with live rockets.

- Immediately after arriving at his plane, a pilot determines that all appropriate circuit breakers are pulled.
- After entering the cockpit, the pilot checks the circuit breakers again, sees to it that the rocket master switch is in the OFF position and that the rocket firing selector is in AUTO.
- All armament switches and circuit breakers remain off until the aircraft has been started and taxied to the arming area at the end of the runway. Here, the circuit breakers are reset and the engine run up to 65 per cent. The pilot then places his hands outside the cockpit while the armorers check for stray voltage.
- If the voltage check is satisfactory, the all-clear signal is given.
- The pilot then turns the rocket master switch to the camera position and checks for a green light. If the green light is on, he returns the switch to jettison and prepares for takeoff.

Rockets are fired only after the chase pilot has cleared the interceptor with two miles to go.



In the Phase I pattern, two interceptors make 90-degree practice runs against a T-33 "target."

All aircraft on the mission, including the tow ship, operate on a common radio channel, with an alternate channel assigned in case of primary channel malfunction. Each mission is flown under the direct control of GCI and, in the event that GCI becomes inoperative, the mission is aborted. The flight leader makes radio contact with GCI immediately after takeoff, and each member of the flight checks in with the controller.

On all firing missions a chase pilot is assigned to the interceptor to insure that the interceptor pilot is locked-on the target (not the tow ship) and that he is within the prescribed angle-off limits. The chase pilot is charged also with seeing to it that all radio transmissions are made correctly by the interceptor. Because these transmissions will vary with different types of aircraft, he must be familiar with all aircrew armament series memoranda.

During the intercept run, the chase pilot transmits a "Tally Ho" as soon as he sights the tow ship. Then, with two miles to go before firing, he observes the position of the tow ship relative to the interceptor and transmits "Clear" or "Break" to the interceptor pilot. By lining up his aircraft with the interceptor and checking the slave compass he makes certain that the plane about to fire accomplishes a 90-degree beam intercept (plus or minus 30 degrees). If these limitations are exceeded the chase pilot instructs the interceptor to "Break," and at that time the attack is discontinued.

For scoring purposes, after the interceptor has fired, the chase pilot observes the apparent rocket dispersal and the flight of the rockets in relation to the target. Finally, he makes sure that the interceptor pilot accomplishes his final armament check before leaving the range.

Immediately after leaving the IP the chase pilot positions his aircraft four plane lengths (approximately 150 feet) directly behind and slightly below the interceptor. Then, with the "Clear-to-fire," he repositions three plane lengths out and 20 feet above the fighter on the side from which the target is approaching. This provides elevation and azimuth clearance from the target and minimizes the possibility of the chase plane flying into falling rocket parts.

## GCI Control

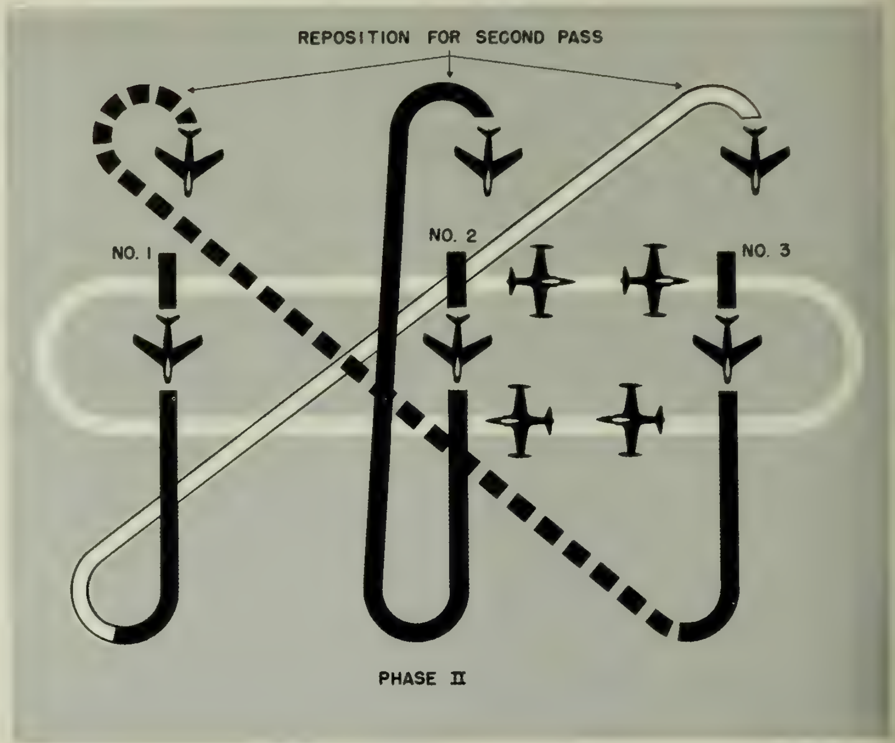
Student controllers, under close supervision, guide the interceptors to the target area, line them up on the target and pick them up again after they have fired.

From the controller's viewpoint, the mission starts when the interceptors are airborne. The fighters take off at 20-second intervals and check in with the controller on the assigned radio channel. The controller makes a radio check with each plane by giving the pilot a vector and angels (altitude) to the operational area. The interceptors climb at 100 per cent military power, 300 knots IAS.

The controller then must identify and place each fighter and the target, preferably by checking their respective courses and by IFF interrogation. If this is not possible, positive identity is made by position reports and given course changes.

Next the controller plans interceptor spacing. With 20-second intervals on takeoff, the planes will be in trail about three miles apart, which is not adequate spacing for firing passes.

Spacing on the 90-degree beam approach should be planned so that the interceptors will "splash" the target at one-minute intervals. If this spacing is set up, the distance between interceptor paths will be equal to one minute of target travel and the distance between the interceptors will be equal to one minute of interceptor travel. The controller makes sure also that the fighters and the target are in a straight line to insure that the angle-off for each interceptor will be equal.



In Phase II patterns, 90-degree approaches are used to practice getting the correct "lock-on."

On the first pass, if the fighters are overtaking the target (that is, the target is going away from the controller), obtaining the desired spacing is simple. The fighters then can continue to their turn-on-points in trail, with two to three mile intervals, and they will reach the turning point with the desired spacing.

If the target is coming toward the fighters on the first pass, spacing can be obtained by fanning them out as they approach the displacement line. If in-trail spacing is still not adequate after they reach the displacement line, No. 2 and No. 3 may be allowed to displace (move out) several miles farther from the target path. When approaching the target from a head-on position, spacing in trail should be equal to one minute of interceptor travel plus one minute of target travel to obtain the desired spacing on the 90-degree approach. Turn-ons then will be one minute apart.

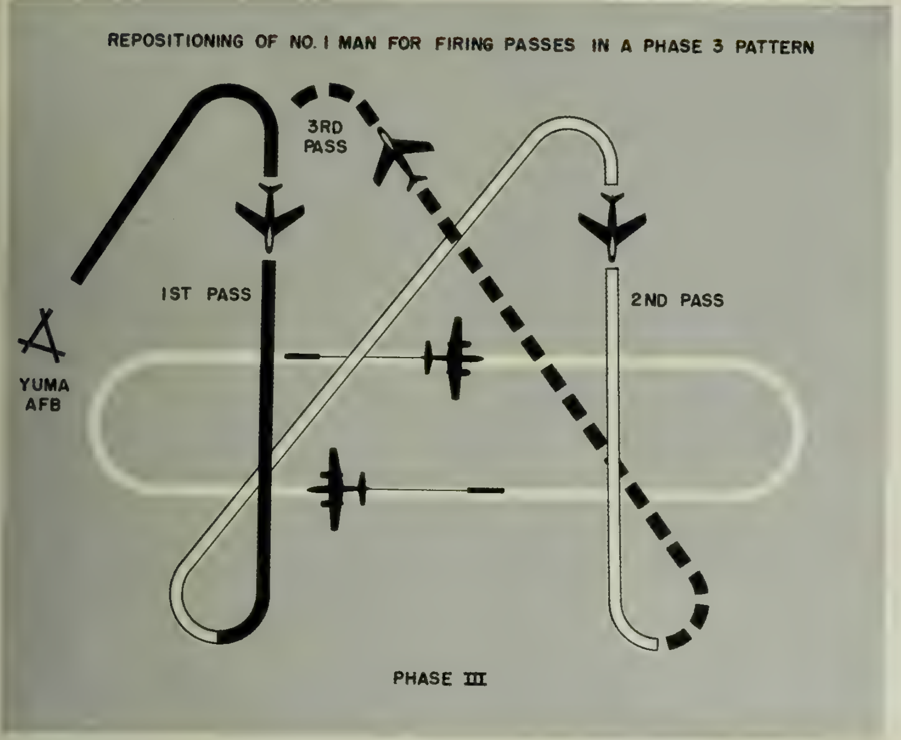
A Phase I mission is flown with the target aircraft flying a race-track pattern tracking on predetermined headings. The first of two interceptors is positioned by the controller to attack on a 90-degree beam lead collision course interception.

The interceptor displacement should be approximately 25 miles after the initial turn-on to the 90-degree beam approach, which allows the fighter about three and one-half minutes on the final approach.

After break-off the controller gives the interceptor a recovery vector that places him 25 miles off the target course and positions the aircraft for another intercept on the target's reciprocal course. Using this position, each interceptor can be given four intercepts during a 50-minute tow target mission.

On a Phase II mission, using two T-birds flying in trail, 5000 to 6000 feet apart to simulate the tow plane and target, three interceptors make dry, practice runs to obtain correct target separation from the tow ship while locking-on to the target.

A 3:2 speed-ratio (fighter 300 knots IAS, tow ship 200 knots IAS) is used in Phase II. The tow plane and the target track on pre-determined headings such as 80 and 260 degrees, at the same altitude. On such


REPOSITIONING OF NO. I MAN FOR FIRING PASSES IN A PHASE 3 PATTERN
3RD PASS
1ST PASS
2ND PASS
YUMA AFB
PHASE III

**In Phase III, interceptors fire, break and are repositioned by the controller for the next run.**

a mission the interceptors make their first attack from 170 degrees. If they are not at attack altitude before turning on the final approach, they must level out with the target before making the interception. All succeeding passes are then made in only one direction from north to south.

Displacement from target is still 25 miles to allow the fighters three and a half minutes on final.

The fighter pilot calls a "Judy" immediately after he obtains a lock-on. If he doesn't call by the time he has two miles to go, the controller breaks him off. If the interceptor "has a Judy" the target aircraft pilot then calls "Tally Ho" when he has a visual on the fighter aircraft.

Finally, after the pilot gets a pull-out signal, he calls "splash" and the controller resumes control and breaks him off to the rear of the target.

To reposition the interceptors, the controller must cross the interceptors' paths to maintain the same order of attack. If each fighter were given a 180-degree turn after the splash, their order would be reversed. On the next pass the No. 1 pilot would obtain about a 40-mile displacement while the No. 3 man would have only a 10 to 15-mile displacement from the target path. The chart shows how the controller can switch interceptor positions and cross their paths to reposition them correctly.

On Phase III missions the controller makes a radio check with each chase aircraft as well as each interceptor. Patterns are about the same as those flown during Phase II. However, each interceptor has a chase plane flying close formation to insure that he is in proper firing position and to keep the fighter clear of any strange aircraft that occasionally stray through the gunnery range area.

Approach pattern and radio calls are the same as those used in the previous phases but after reaching the "two mile point" the radio channel must be kept clear of all transmissions. At this time the tow aircraft should be directly ahead of the interceptor and the chase plane can tell whether the fighter is locked-on the target or the tow ship. It is during this phase that the chase pilot clears the interceptor pilot to fire or breaks him off the pass.

Each participant in the mission, that is, the interceptor pilot, the chase pilot, the tow pilot and the controller, must have two-way radio contact with all other participants. This is an absolute necessity as anyone who sees a dangerous situation developing must be able to call "Break." (They all have the break prerogative.)

As an example, if the chase pilot sees that the interceptor has more than a 30-degree angle-off on his 90-degree beam approach he then calls to the fighter to "Break."

Fuel and oxygen checks are made after the first, third and each succeeding pass. Interceptors are not allowed to begin another pass if they have less than 1500 pounds of fuel.

The B-45 tow aircraft crews are another indispensable part of the interceptor training program. By following established SOPs and getting maximum aircraft utilization they enable the TDY units to receive full training in the allotted time.

Before the start of a tow mission, the aircraft commander briefs the crew on the overall procedure to be used, with emphasis on possible inflight emergencies. The crew chief reports on the aircraft's status and the tow reel operator reports relative to the tow reel and target equipment.

The rolled up, 9′ x 45′ marquisette target is carried in the plane's bomb-bay. If the tow altitude is 20,000 feet, the B-45 is slowed up to 120 mph indicated at 21,000 feet. Next, the target is attached to a cable at least 5000 feet long, released and reeled out of the bomb-bay at 400 to 600 fpm. If tow altitude is 30,000 feet the procedure is the same, except that the target is let out at 3000 feet above tow altitude.

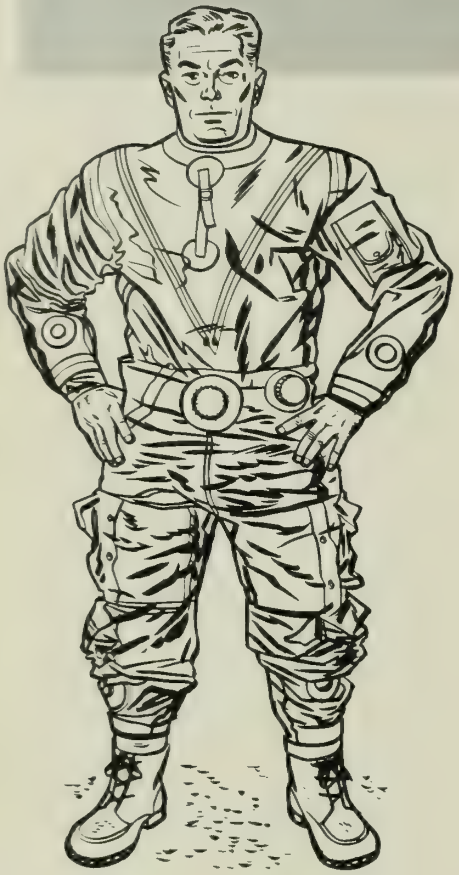
Contact is maintained with the GCI controller throughout the mission. The controller positions the tow ship in such a way that he can get the interceptor on the firing pass immediately after the target is let out.

In any case where an interceptor pilot doesn't follow the SOPs to the letter, the tow squadron can cancel the rest of that individual's missions until he gets enough additional training to be capable of flying armed rockets against a tow.

After a mission the B-45 lets down, drops his target from 2000 feet at 150 mph over the target recovery area and returns to base. The aircraft commander must plan his mission so that he will have a minimum of 500 gallons of fuel on initial approach.

Ever since high flying, fast bombers became capable of bombing a target in any kind of weather, using radar, our first line of defense has been the U.S. Air Force interceptor. The training received by the Air Defense Command's pilots at Yuma AFB is one more strong link in this Nation's chain of defense. ●

# the HEAT is OFF



MAN, sometimes considered the weaker link, may one day have the capacity to withstand the rigors of supersonic, high-altitude flight better than the machines that carry him. Now being studied and tested as a possible addition to the ever-growing list of protective clothing is an air conditioned anti-exposure suit.

An experimental model of the suit, developed by the Air Research and Development Command's Wright Air Development Center, already has proved satisfactory in early trials. The test program is being accelerated because of the rapid development of high-performance aircraft.

As its name implies, the suit is designed to provide dual protection. It provides air conditioning for protection against heat and is equipped with insulation and a water-proof outer shell for protection against cold and water. In addition, it can be used with an anti-G suit and with a partial pressure suit.

Man's battle with the elements, so far as flight is concerned, began when Orville Wright lifted the first airplane off the ground at Kitty Hawk. At that time the only protective device needed was a pair of goggles to protect the eyes from the wind.

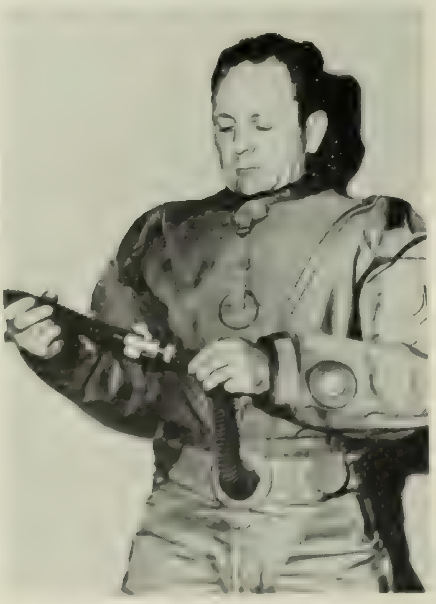
As flight became more commonplace and speeds and altitudes increased, the need for protective devices grew by leaps and bounds. First came the parachute and seat belt, then insulated clothing and oxygen masks. As the range of aircraft was extended to include flights across continents and over oceans and between temperate and torrid zones, the anti-exposure suit became a must.

With the advent of higher speeds, gravity forces had to be reckoned with and the G suit was developed. As planes climbed higher, pressurization became necessary and took the form of both cabin pressurization and pressure suits.

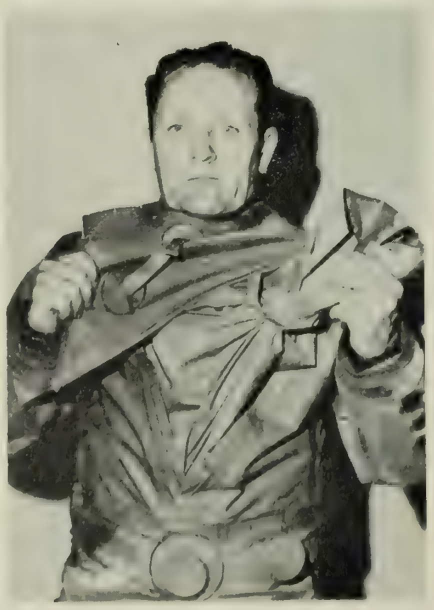
The air conditioned suit became a necessity as planes approached the speed of sound and beyond. At these high speeds a new problem was encountered that was promptly named the "thermal barrier."

Actually, the thermal barrier is not a barrier in the sense of a sonic barrier. Airplanes that have passed through the sound barrier have found flight conditions relatively calm above the speed of sound. But there is no point at which airplanes can pass through the thermal barrier and find a relatively cool climate.

**Air entrance assembly, with quick disconnect and sealing hose snapped over entrance port.**



**The V-closure, with the zippered flap opened, illustrates how the water barrier is knotted.**



**For additional comfort the insulated liner is worn as a part of the anti-exposure suit.**

Heat increases as speed increases. It has been determined that at Mach 3, or three times the speed of sound, at sea level, temperatures at the airplane skin will go up to 1000 degrees Fahrenheit. Not only man, but instruments and most other fittings inside the airplane would be baked to a crisp inside such a flying oven.

Thus, air conditioning of high speed airplanes became a necessity. The big problem, it soon developed, was to construct an efficient air conditioning system that left room in the airplane for little necessities such as the pilot and his equipment.

Instruments have been designed to operate efficiently at a maximum of 165 degrees Fahrenheit. Tests showed that such a temperature was feasible insofar as air conditioning system weight and space factors were considered. But for man, loaded down with an anti-exposure suit, anti-G suit and partial pressure suit, such temperatures would be unbearable. He would not be able to fly long enough to accomplish a mission.

Starting with the anti-exposure suit, AeroMed Lab engineers and medical men soon determined that a water-proof insulated suit which would enable man to withstand temperatures of 30 degrees Fahrenheit indefinitely and would protect him for about one hour at —30 degrees, would be comfortable up to 50 degrees, but not for long above that mark. At the normal 80 degrees in a cockpit, the pilot's efficiency would be impaired after about two hours, and at the 165-degree goal of airplane air conditioning, the pilot would be unable to operate after 30 minutes of flight.

Therefore, without the cooling effect of the air conditioned anti-exposure suit, it would be impossible for a pilot to operate efficiently.

In approaching the problem of making a suit comfortable from a temperature, bulk and weight standpoint, the engineers and medical men decided to take advantage of the cooling quality of evaporation of man's own perspiration.

This posed a problem in that some people are "poor sweaters," but in 1953 it was discovered that even they produce sufficient water for heat transfer by evaporation under the conditions encountered in this case.

A new principle for air distribution throughout the suit was developed. This abandoned completely the principle which seemed to be most natural, the use of air distribution hoses for cooling.

The suit finally developed consists of two layers of thin, impermeable fabric. The inner layer is provided with a large number of small holes, through which the air passes during ventilation. Sandwiched between the two layers is a flexible spacer material, which facilitates airflow in all directions. Larger holes go through both layers and connect inside and outside of the ventilating suit, to facilitate the air motion exchange.

**Between the two layers of the suit is a flexible material which facilitates the airflow.**

**Visible at the left is the connection hose attached to the anti-G suit worn underneath.**

By using the standard cabin air conditioning system, cooling air is introduced into the suit through a flexible hose with throttle and quick-disconnect. The air flows through the suit and exits through four valves at the end of each extremity. The exit valves are opened by the outcoming air and closed watertight by a spring as soon as the airflow stops.

Since the suit is to double as an anti-exposure garment and must be water-tight, the neck and both wrists are sealed by elastic rubber seals. The lid on the quick-disconnect will close on separation and prevent water from entering the suit. It is shaped in such a way that it will not accidentally open if the wearer is dunked.

The point where the air supply hose penetrates the outer shell is sealed with a sealing hose which can be folded backward and snapped over the rim of a plastic threaded port. The port can be closed with a cap screw when the ventilated inner suit is not used.

To combine this suit with an anti-G suit, a second plastic cap screw has been placed on the left side. A third one would be added on the right side if the use of a partial pressure suit is intended.

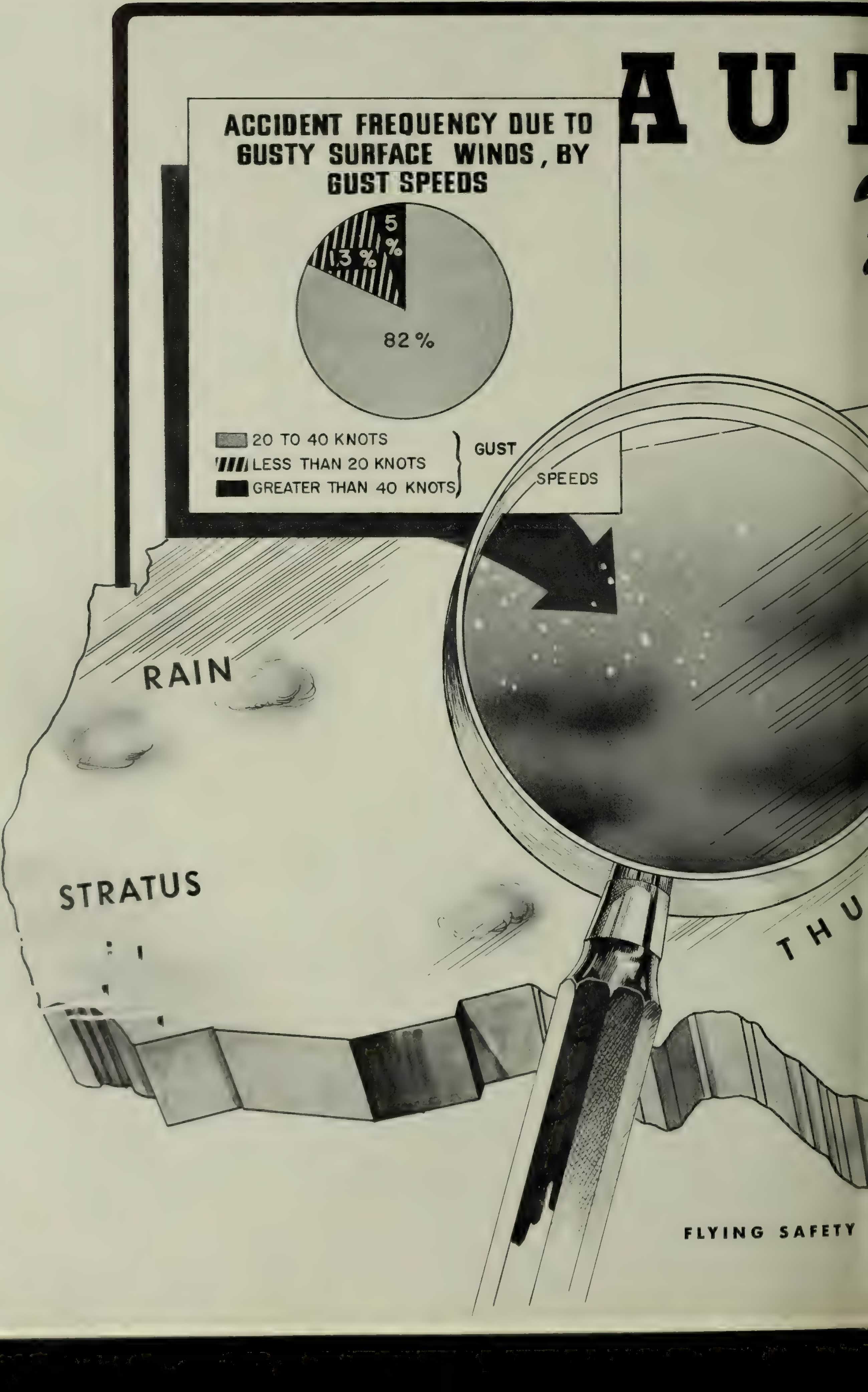
A watertight suit as complicated as this one also needed a special closure to make donning easier. A V-shaped zippered flap opens to disclose a water barrier which is tied into a tight knot.

Preliminary tests were conducted on two men and then averaged. In all tests, the volunteers wore the air conditioned anti-exposure suit, a set of medium weight underwear, a back parachute, a crash helmet and in some tests, an oxygen mask. The tests were run for three hours each with the men in sitting positions.

Starting with an outside temperature of 90 degrees in the first test, increasing to 120 in the second, 140 in the third and 165 in the next five tests, the ventilating air temperature was reduced from a high of 127 degrees down to 45 in the sixth, seventh and eighth tests.

Since these and additional tests have proved that air conditioning of a pilot's suit can maintain him in thermal comfort even when the cockpit temperature is 165 degrees, use of this suit will make it necessary only to maintain the 165-degree temperature inside an airplane. This, in turn, will save bulk and weight in cabin air conditioning. ●

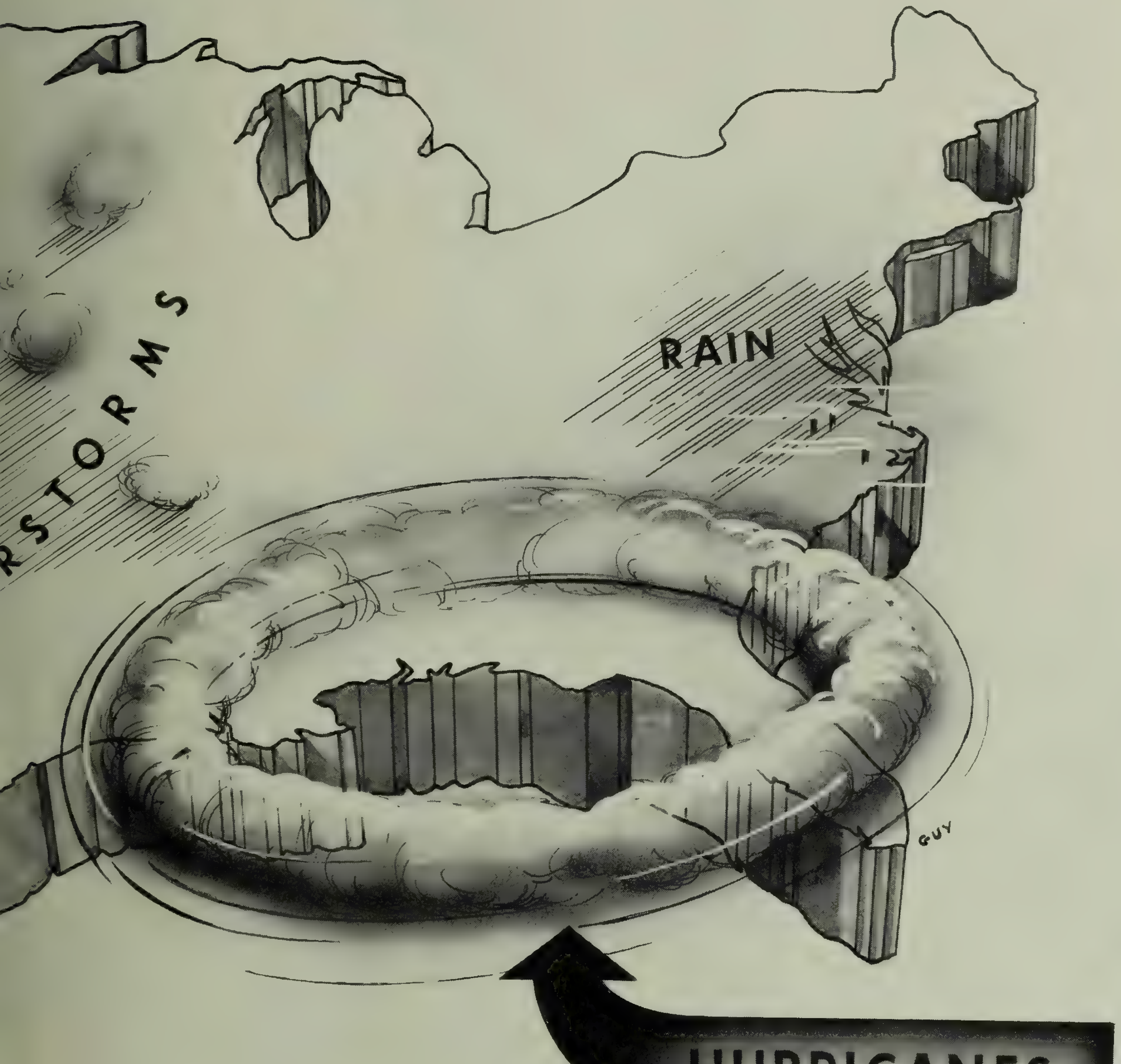
# AUT


ACCIDENT FREQUENCY DUE TO GUSTY SURFACE WINDS, BY GUST SPEEDS
5%
13%
82%
▨ 20 TO 40 KNOTS
▨ LESS THAN 20 KNOTS
■ GREATER THAN 40 KNOTS
GUST SPEEDS
RAIN
STRATUS
THU

# UMN

# ying Hazards

Hazards to flight during the fall months are discussed in this article prepared by Maj. Clarence E. Everson, Directorate of Climatology, AWS.



AUTUMN, in many ways, can be considered a sort of catch-all season as most of the familiar weather hazards occur to some extent during the autumn months. This is to be expected, since the autumn season constitutes a transitional period between summer and winter weather situations. Although thunderstorms do not occur as frequently in autumn as in summer, they do appear often enough to be considered among autumn flying hazards, particularly in the middle and late portions of the season. Except for the hurricane, no one weather hazard is quite so prominent in autumn as it is in one of the other seasons of the year.

A collection of aircraft accident data for a recent six-year period was studied to determine which weather factors contributed to the greatest number of accidents during autumn months. Only those accidents in which weather was a factor were considered in this analysis. The relationship between primary contributing weather factors and the percentage of accidents is illustrated on page 14.

### Surface Winds

The most significant feature demonstrated by this analysis is the fact that the largest percentage of aircraft accidents in the autumn season were due primarily to unfavorable surface winds. Unfavorable surface winds caused almost as many aircraft accidents as a combination of any other three of the factors. This may be a bit surprising, since it might well have been anticipated that such factors as cloudiness or restrictions to visibility would head this list.

Unfavorable surface winds are defined as cross winds, gusts or a combination of the two. Gusts were reported in a high percentage of the cases of unfavorable surface winds.

On the preceding pages the chart shows the relative frequency with which gust speeds in selected ranges contributed to aircraft accidents. This representation clearly demonstrates that gust speeds in the range of 20 to 40 knots contributed to aircraft accidents much more often than did speeds of over 40 or under 20 knots. This is probably because gust speeds in the range from 20 to 40 knots occur far more often than do speeds greater than 40 knots, and that gust speeds under 20 knots may be less critical for most flight operations.

Most of the accidents resulting from unfavorable surface winds took place in three general areas. The south central United States was the area in which the greatest number occurred. A significant number occurred in the east coastal states, while the southeast and northeast coastal states appeared to be preferred regions, with few accidents in which wind was a factor. A third area of importance in this report was the southwestern part of the United States.

Surface wind speeds of 15 to 25 knots, which are most frequently associated with gust speeds in the 20 to 40-knot range, occur most often in the midwestern states, particularly in an area defined by Wyoming and South Dakota on the north and by Texas on the south. In this area, these wind speeds occur on the average from 20 to 35 per cent of the time. The higher percentage values are found in the Kansas, Oklahoma and the Texas Panhandle area.

Most of the accidents in which rain, clouds and fog were primary weather factors took place in the east and west coastal states and the Great Lakes region. The same areas coincide closely with the regions of greatest frequency of occurrence of those weather factors.

Thunderstorm activity is less pronounced in autumn than in summer, but still constitutes a definite autumn flying hazard. Thunderstorms are more frequent in the midwestern states than in western states. The number of thunderstorms decreases as the season progresses, so that they tend to become a less significant hazard in late autumn than in early autumn. Only a small percentage of those accidents due to thunderstorms actually took place within the region of greatest thunderstorm occurrence. The Ohio Valley stands out as a preferred area for thunderstorm-caused accidents.

During middle and late autumn, hazards common to the winter months begin to appear on the scene. Freezing precipitation and snow account for only a small percentage of accidents, but should not be disregarded as definite hazards. The north central states and the Great Lakes region are the areas primarily affected by these factors.

### Hurricanes

The most outstanding feature of the autumn weather situation is the hurricane, with its destructive winds and torrential rains. The paths of many of these hurricanes pass over the Gulf coastal and south Atlantic coastal states or in that vicinity.

The hurricane season begins early in the summer and extends through most of the autumn period. A study of records compiled over many years shows that a greater number of hurricanes have affected the United States during the autumn months than during the summer months. During June and occasionally in July, hurricanes tend to develop in the western Caribbean Sea and move in a northwesterly direction into the Gulf of Mexico. They then follow a path either into Mexico or the Gulf states. During August and September, and sometimes in July and October, the tendency is for hurricanes to develop south of the Cape Verde Islands. These quite often recurve in the Caribbean or in the Gulf of Mexico, after which they tend to move north or northeastward, their path taking them into or near the southeastern states. In late September, hurricanes once again tend to develop in the western Caribbean Sea and follow paths similar to those followed in June, while in October and November they are more likely to recurve to the north or northeast and pass over or near Florida.

Hurricanes move slowly, usually at about 8 or 10 knots. Winds associated with them are exceptionally strong, speeds of 100 to 125 knots not being unusual. The diameter of hurricanes varies somewhat, in some cases being as little as 50 or 75 miles while diameters of over 500 miles have been noted. Heavy rainfall is generally associated with hurricanes, on occasion exceeding 20 inches in a 24-hour period.

Specific information on the number of aircraft accidents attributable to hurricanes is not available. However, it is believed that this number is relatively small in comparison to the number of accidents resulting from other weather factors. Timely hurricane warnings for a given area permit taking the necessary precautions against this hazard. Nevertheless, the fact remains that the hurricane, one of the most dramatic of weather features, does represent a most serious flying hazard during the autumn season in the Gulf and Atlantic coastal states.

To summarize, a wise pilot will remember that autumn flying weather incorporates many of the hazards of both winter and summer weather, and will plan accordingly. ●

# *OFF* FOR LANDING!

THE THEORY goes something like this, "heavier than air machines, correctly designed, can perform sustained flight with the aid of sufficient propulsion."

This story concerns the B-25, a versatile aircraft about which there is no doubt as far as its flying ability is concerned — with the aid of two R-2600s, that is. Likewise, there is little doubt as to its rocklike tendencies when *both* fans cease to rotate.

This episode really started when a pilot made a left turn onto the downwind leg in a B-25. The mixture controls were placed in full rich, propeller controls advanced to 2200 RPM, fuel booster pumps switched on and the landing gear lowered. The copilot checked the engine instruments and stated that they appeared normal. Seconds after the gear was lowered, a third crewmember, seated behind the pilot, shouted that the left engine was cutting out. The left engine was observed to run rough and vibrate in its mounts while black smoke began pouring from the stacks.

Shortly thereafter, the copilot noticed black smoke emanating similarly from the right engine with subsequent partial power loss. Upon the first indication of trouble, both propeller and throttle controls were advanced full forward. The mixture controls were put into the cruising lean position and, after no change in engine performance was noted, returned to full rich.

From the beginning of the engine malfunctions, the pilot primarily concentrated on maintaining airspeed and directional control of the aircraft. He stated that he started descending rapidly while maintaining 150 MPH airspeed. Seeing that it was impossible to reach the runway, the pilot feathered the left engine and selected a field for a forced landing. The landing gear control was placed in the up position and, prior to touchdown, the master ignition switch was turned off. The fuel booster pumps were not turned off at any time. The aircraft made contact with the ground on its partially retracted main gear and skidded to a stop.

Fortunately, double engine failure doesn't happen too often. When it does happen, investigation as to the cause takes on a different slant than the run-of-the-mill engine failure investigation. It just isn't likely that both engines will fail at the same time due to metal fatigue, a blown jug or for any other similar reason.

Investigation of this accident uncovered the possibility of flooding the engine by excessive fuel pressure. It was determined that B-25 aircraft engines equipped with Holley carburetors are subject to flooding when fuel booster pumps are turned on, if inadequate voltage control on the aircraft electrical system allows voltage to exceed normal limits. This condition can cause complete loss of engine power.

There are two B-25 modification programs underway to eliminate this engine flooding deficiency:

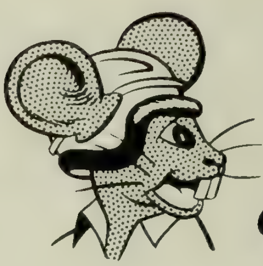
- Replacement of Holley carburetors with Bendix carburetors, which operate satisfactorily over a much wider range of fuel pressures.
- Provision of an overvoltage protection feature in the electrical circuit to prevent overspeeding of the boost pumps in the event malfunction causes excessive voltage in the system.

Pending modification completion, a pilot should check the recently issued Safety of Flight Supplement to the B-25 Pilots Operating Instructions. This supplement warns of the possibility of engine stoppage due to excessive fuel pressure from the booster pumps and instructs pilots to leave the pumps off for landing until the modifications are made.

In addition, since a modified aircraft is not easily recognizable by the pilot, the unmodified aircraft will be placarded to indicate that booster pumps should be left off for landing.

The Flight Supplement concerns itself primarily with booster operation on landing; however, it figures that overspeed on takeoff could have the same dire results unless proper pre-takeoff checks are made. By heeding the Safety of Flight Supplement and the Pilots Operating Instructions you can't go wrong. Page 31 of the Dash One outlines the procedures for checking fuel booster pump operation prior to takeoff. The whole secret is in the voltage and/or fuel pressure output. An excessive voltmeter reading and/or fuel pressure indication in excess of 8 PSI is a clue to possible trouble and calls for scratching the flight and a Form I writeup. ●

# ANYMOUSE and his hairy tales



Judging from reports received from the field, it looks as if the article on Anymouse in the May issue has stirred up considerable interest among the troops. Near accident reporting systems are in effect in several major commands, and many base flying safety officers have started local programs also. In order to get maximum coverage, FLYING SAFETY is printing some of the reports recently received. Crew members are encouraged to send us any narrative of a near accident or unusual experience for publication. Remember, as the name implies, it isn't necessary to sign your *anymouse* reports . . . just give us the facts.

IT WAS one of those black, raining, miserable nights and we were preparing for a cross-country flight. After a careful walk-around inspection, the copilot and engineer followed me into the cockpit of our C-47. We received clearance from the tower and started out toward the active runway.

The weather forecaster had given us a thorough briefing and we were expecting stratus-type clouds with rain and light to moderate rime ice.

Following runup and accomplishment of the normal amplified checklist, my copilot and I ran through the night-instrument check. Everything, including auxiliary equipment such as de-icer boots, carburetor heat and windshield anti-icing worked OK.

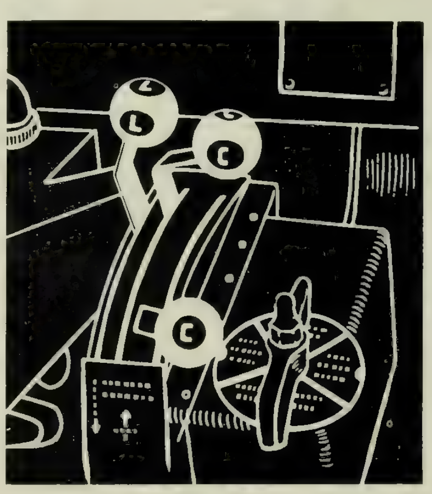
We received tower permission to take off and away we went, into the black. Passing through 1000 feet on instruments, I requested the copilot to check engine instruments and to turn off the fuel booster pumps, one at a time. It was then the copilot shouted that the right carburetor heat was up in the red *and climbing.*

Now, let us go back to the pretakeoff preparations. During the checking process the co-pilot had actuated the carburetor heat controls and, after a temperature rise on both engines was noted, returned them to the cold (forward) position. He then pulled what he thought to be the carburetor heat control lock to the aft (locked) position.

The three controls, right carburetor heat, left carburetor heat and the lock, are side-by-side and feel and look very similar.

The copilot had inadvertently pulled the right carburetor heat to the hot (aft) position thinking it was the control lock. We had taken off with the heater controls in this position.

Fortunately, with the aid of a flashlight, the controls were repositioned before any serious trouble occurred; but don't think we didn't have a few anxious seconds.



*Using that flashlight was a good idea; it was just used (about 1000 feet of altitude plus runway length) too late. On night flights, before and after positioning switches and controls, get some light on the subject. This is particularly important during the pre-takeoff and landing checks.*

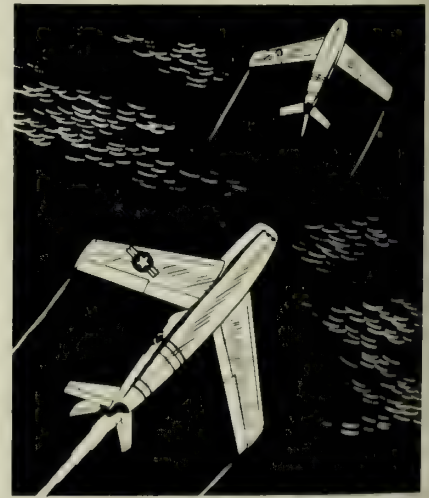
*This might be a good time to bring up the differences between carburetor heat set-ups in C-47s. There are three types; one incorporates the ram, hot and filtered positions, another has the cold (forward) and hot (aft) controls with in-between positions and yet another has a control behind the pilot's seat tied in with the temperature controls located to the right on the pedestal.*

*Know your airplane and use your light at night—It's good insurance.*

Two F-86Fs were "rat racing." The leader nosed over into a dive at a reduced power setting and executed a four G pull-up at about 13,000 feet. In the meantime, the No. 2 man had fallen back and was hustling along to catch up and regain his proper in-trail position.

At the point of pull-up the No. 2 man pulled back abruptly on the stick and simultaneously poured on full throttle. He noticed the tailpipe temperature had increased to 1000 degrees and sensed a compressor stall.

The pilot immediately lowered the nose and reduced power to correct the over-temperature condition. The temperature returned to normal and the aircraft was returned to base and landed without further incident.



On a routine flight, another F-86F had three compressor stalls and a subsequent flameout. A normal airstart was made, but the tailpipe temperature went to 1000 degrees for about four seconds before returning to normal.

Experimentation proved that throttle manipulation, other than a very slow movement, caused a compressor stall and a high tailpipe temperature. By exercising care and making throttle movements slowly and in small increments, the pilot was able to fly the F-86 home, baby it around the pattern and land it normally.

*Compressor stalls are indeed with us. If you keep in mind what causes them, you greatly increase your chances of getting things under control and landing without further compressor difficulty.*

*A compressor stall is nothing more than improper fuel-air ratio. The stages for setting up an unfavorable fuel flow condition are:*

- *Having the emergency fuel system on or alerted (either intentionally or by electrical malfunction) followed by rapid throttle movement.*
- *Fuel regulator malfunction resulting in improper fuel scheduling followed by rapid throttle movement.*

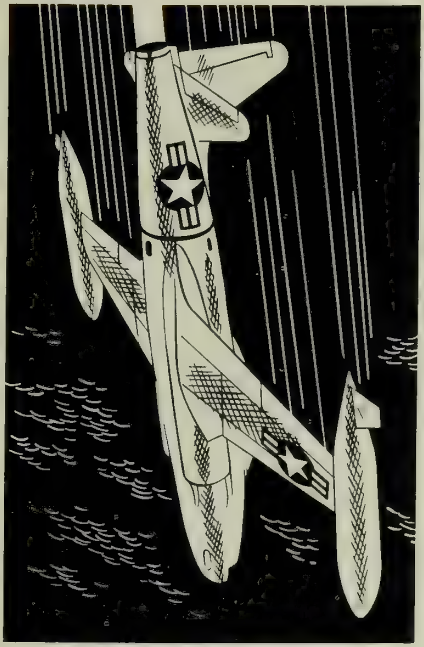
*The trick lies in recognizing quickly that a compressor stall has occurred. The key to minimizing danger or damage lies in your left hand (that's the throttle hand, son). So, avoid those abrupt throttle movements and there's no sweat.*

★ ★ ★

A student took off in a T-33 to practice acrobatics. He climbed to 15,000 feet and circled, expending tiptank fuel.

As soon as the tiptanks were dry, he executed a few chandelles and then performed a loop followed by an immelmann. He then tried to do a clover leaf. He entered it at 17,000 feet, indicating 320 knots with a power setting of 90 per cent RPM. He completed the first leaf of the maneuver satisfactorily. As he started into the second leaf, from an approximate 30-degree nose-low attitude, he came back on the stick, pulled about 3 G and blacked out.

The student recovered from the blackout at approximately 7000 feet and found he was in a vertical dive. He retarded the throttle instantly and applied considerable back pressure to recover. The airspeed was at or near the red line, and the student blacked out again.



Upon regaining his senses, he discovered he was at 3000 feet in a 60-degree nose-low attitude. Immediately he fed in full nose-up elevator trim, pulled back on the stick and blacked out for a third time. This time he woke up to find himself at 8000 feet going straight up. A vertical recovery was accomplished at 130 to 150 knots I.A.S. and the aircraft was successfully returned to the base. Damage to the horizontal stabilizer occurred during the violent pull-ups.

★ ★ ★

*The hazards involved in pulling an excessive amount of G forces are pretty obvious. Aside from damage to the aircraft, incapacitating the pilot of a high speed aircraft, even for only a few seconds, places him in an undesirable position, to say the least.*

*In this particular episode, the actual pulling of the G forces was secondary to the fact that the pilot attempted maneuvers beyond his capabilities. It's justs plain good sense never to attempt difficult acrobatics in an airplane with which you are not too familiar, until the maneuvers have been demonstrated to you by a qualified instructor pilot and you're convinced of your own proficiency.*

*By the same token, it is obvious that the hazards involved in taxing your ability to the breaking point applies to all types of flying, not just acrobatics. Skill and proficiency gained through practice will equip today's Air Force pilot for the type of flying required of him, whether it is performing acrobatics or accomplishing a socked in instrument letdown.*

*Know your airplane, know yourself, fly accordingly. No one knows your capabilities as well as YOU.*

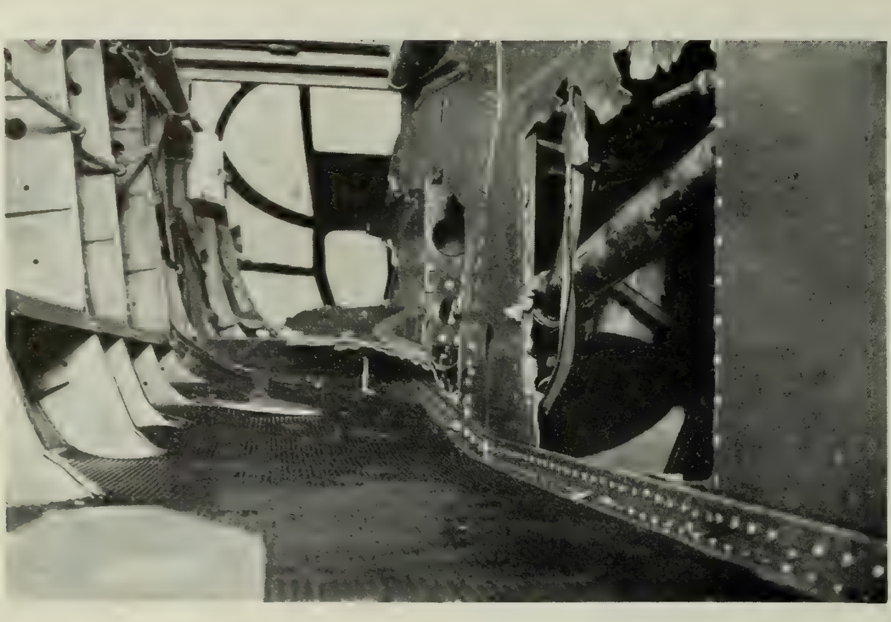
★ ★ ★

A T-33 fired up and started taxiing out to begin a two hour cross-country flight. The T-bird had been cleared by the tower to take the runway, and upon reaching the takeoff position, most of the pre-takeoff checks had been accomplished. The main and leading-edge wing tanks had been checked for operation and there were five green and no red lights showing.

Almost immediately after getting into takeoff position the tower advised that an emergency aircraft was on a long final and that the '33 was cleared for IMMEDIATE takeoff.

In expediting, the pilot either forgot or neglected to take time to pull power and check the tiptanks for proper feeding. You guessed it, the tips wouldn't feed and the pilot ended up kicking them off before landing.

*The lesson here is obvious. You're asking for trouble, needlessly, when you omit any part of that pre-takeoff check. When you have to get off in a hurry (on a scramble, for example) practice getting that checklist accomplished in an orderly, systematic manner. Sometimes speed is vital, and if you have a set checklist, you can get off fast, and have everything available to accomplish your mission.*



**An interior view of the B-25 shows where, with the aid of a fire axe; pilots chopped holes in the panels to locate the broken section of the hydraulic line.**

**A fire extinguisher was used as a weight after the first transfer attempt had failed.**

# End of the line

IT WAS about 0930 of a spring day, and business was strictly routine in the Shaw AFB tower. The operator on duty was watching an airplane grow from a silent black speck in the pale blue sky to a full size B-25 approaching the traffic pattern for landing. He exchanged the usual information with the '25 pilot.

Business in the aircraft cockpit was routine, too. Aboard the '25 were a USAF pilot, 1st Lt. Elton J. McClure, and an RAF exchange officer, Flight Lieutenant Desmond Nixon, both stationed at Shaw. They had been on a training flight in the local area.

All this quiet routine came to a sudden end, both on the ground and in the air, when in the traffic pattern Lt. McClure placed the landing gear handle of the '25 in the down position and received an unsafe indication. McClure immediately advanced the throttles and pulled up above traffic altitude, while Nixon relayed the news to the control tower operator.

Now earnest activity began. The tower operator alerted the crash crew, then quickly got in touch with the operations officer and the engineering officer. In short order, these two men, accompanied by the base commander and his executive officer, gathered on the parking ramp outside operations and watched the crippled aircraft cruising in the distance.

Meanwhile, aboard the '25 the two pilots were holding a consultation. They decided they might have a faulty hydraulic line. They had enough fuel to stay airborne while they investigated the situation, so while Lt. McClure flew the aircraft, Flight Lt. Nixon grabbed the crash axe and began to chop holes in the panels covering the lines.

Within a few minutes he had located the bad line. But the situation hadn't improved any, for the question now was how to make repairs in the air. The latest news was radioed to the tower operator, who in turn relayed it to the waiting group on the parking ramp.

These men now held a consultation of their own. The faulty line easily could be repaired in the air, if the pilots had the necessary parts. It was a big *if*. Naturally, the '25 wasn't flying around the local area loaded with spare parts and tools.

But the men on the ground had an idea. Before they tried to put it into action, however, they wanted to be sure the pilots had isolated their trouble. Another B-25 was parked on the ramp, so while the stranded pilots churned round and round overhead, the engineering officer and his men lifted the parked aircraft on jacks and destroyed the same hydraulic line in order to simulate the conditions that existed in the air.

Satisfied that the pilots had diagnosed the trouble correctly and that the line could be repaired in flight, Colonel J. R. Dyas, the base commander, accompanied by a copilot, the operations officer and an engineering officer, climbed into a C-47 to accomplish a peculiar kind of rescue. Their self-assigned task was air-to-air transfer, from the C-47 to the B-25, of a kit containing the necessary tools

The cut rope, minus the repair kit and parts, was mute evidence of a successful transfer.

The C-47, flying above the disabled B-25, lowered the necessary parts and tools. With less than one hour of fuel remaining, wheels were finally down and locked.

and parts to make repairs in the air.

While the C-47 took to the air, the Shaw AFB executive officer settled down in the cockpit of another B-25 parked on the ramp and prepared to radio instructions on making repairs.

Around the radio in base operations, anxious ears listened to the conversation between the C-47 and the B-25 pilots. Along the flight line, anxious eyes watched the horizon. By now fuel reserve in the B-25 was getting low. The two pilots could stay aloft only about two and a half hours more. Either they repaired the line in that length of time or they skidded down the runway, sans wheels.

The plexiglass nose panel was knocked out to serve as an entrance for the repair kit.

It was past noon when Colonel Dyas maneuvered the C-47 into position above the B-25. The engineering officer aboard tied the repair kit to a long rope. At 1245 the first pass was made, but the rope had too little weight on it and there was too much play to make a successful transfer. The kit was hauled back aboard the '47 and a fire extinguisher was attached to the tools and parts for additional weight.

Again the rope was lowered. This time it swung within Flight Lt. Nixon's grasp but a gust of wind pushed it into one of the propeller blades, slashing the rope. The kit hurtled off into space.

There was one more kit aboard the '47, but apparently there was no way to get it to the pilots in the B-25. A crash landing seemed inevitable. But Colonel Dyas had another plan. The transfer could be made in a manner roughly similar to that used for midair refueling.

He instructed McClure and Nixon to knock out a section of the plexiglas in the nose of their aircraft. The audience around the operations radio knew this had been accomplished when they heard Flight Lt. Nixon's crisp British voice observe to no one in particular, "There's a bloody gale blowing through this aircraft!"

Carefully, Colonel Dyas maneuvered above the '25. The engineering officer lowered the second kit. Like threading a needle, he slipped the rope through the open canopy section of the plane below. The rope was cut, and the parts and tools were in Nixon's arms. Now it was all up to the two pilots in the B-25.

Cold air blowing through the cockpit forced them to lose altitude. They dropped down to 2500 feet where the air was warmer. With a little over an hour's fuel supply left, they began their repair work, while the C-47 continued to fly escort.

In less than half an hour, the '25 pilots reported that the new section of line was installed. However, lack of pressure still prevented the gear from extending. Colonel Dyas advised Lt. McClure to bleed the line a little to allow some of the air to get out. After doing this, Flight Lt. Nixon went to work on the hand pump. Finally, enough pressure was built up to get the gear down and locked.

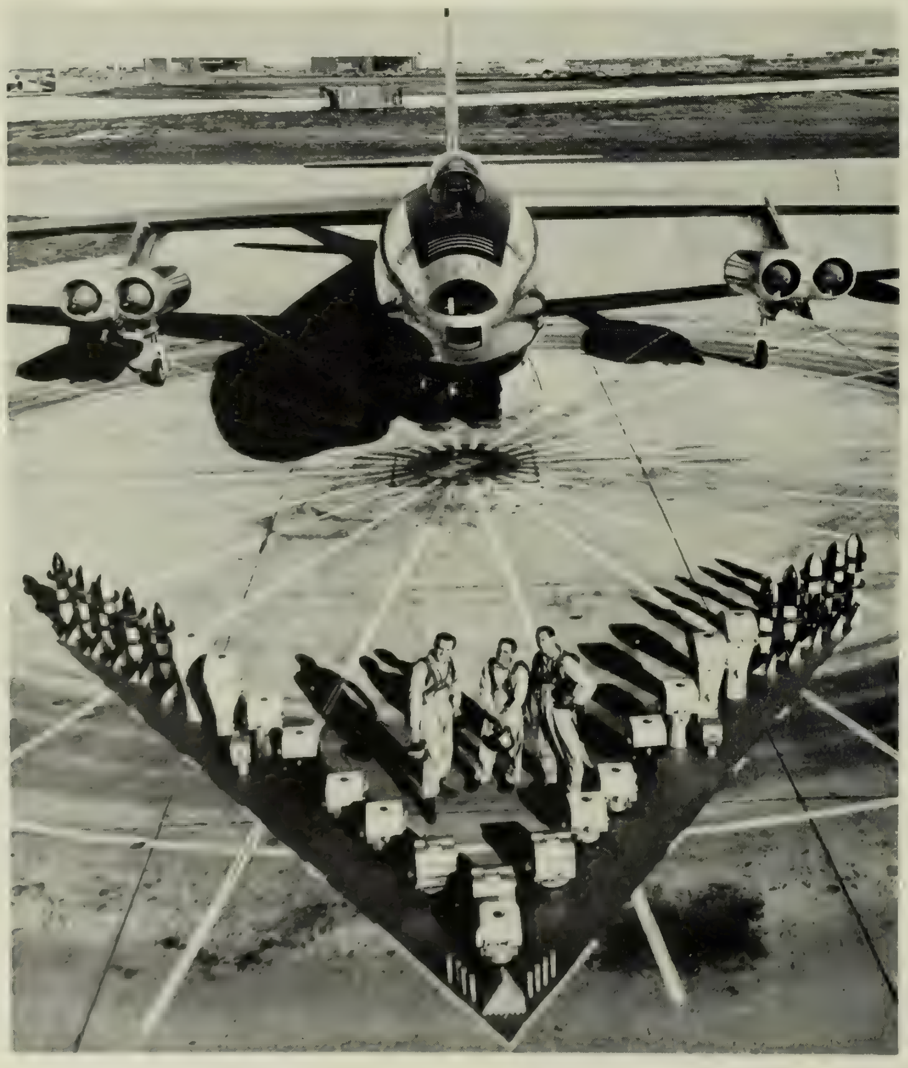
At 1434, with less than an hour's fuel left, the B-25 touched on Shaw's runway, relatively intact.

The credit for this operation lies not with just one or two individuals but with a whole group who, with their combined skill and spirit of cooperation, were able to work together to do what no one of them could have done alone. ●

# Keep Current

**The Eyes of SAC** — The eyes of America's Strategic Air Command are its photo reconnaissance units, and the Boeing RB-47E, newest photo-recon plane to go into service with SAC, is well equipped to serve as such. Similar in performance and dimensions (except for a longer nose) to the standard six-jet B-47 medium bomber, the RB-47E's equipment includes 16 cameras, any seven of which can be carried at one time, depending on the mission.

With their airplane serving as a backdrop, pilot, copilot and photographer-navigator of an RB-47E are shown here with their available photo equipment. The cylindrical objects in the foreground are cartridge flares, while those at the extremities of the "V" are flash bombs. The remainder consists of the 16 cameras and two photocell-operated shutter trip units.



★ ★ ★

**Good to the Last Drop** — A four engine airliner lost hydraulic pressure and the gear did not retract all the way after taking off. The fluid continued to leak at a slow rate. The captain elected to land and needed some kind of fluid to pump the gear into place and lock it. The liquids from the buffet were put into the hydraulic system (such as coffee, juice, etc.) and last but not least the wash basin water from the powder room was used. A short time later the gear was pumped into place and locked and a successful landing was made, with no damage to the aircraft.

★ ★ ★

**Straight and Narrow** — Recently, the 18th Fighter-Interceptor Squadron at the Minneapolis-St. Paul International Airport completed transition to F-89D aircraft. To facilitate movement of the aircraft in and out of the alert hangar and to eliminate the possibility of scraping the hangar walls with the rocket pods, an assistant line chief designed a nosewheel guide rail which has proved almost foolproof. Locally manufactured by Air Installations, the guide consists of a rail bolted to the center of the hangar floor in position to fit between the two wheels of the nose gear, making it impossible for the plane to deviate from proper alignment.

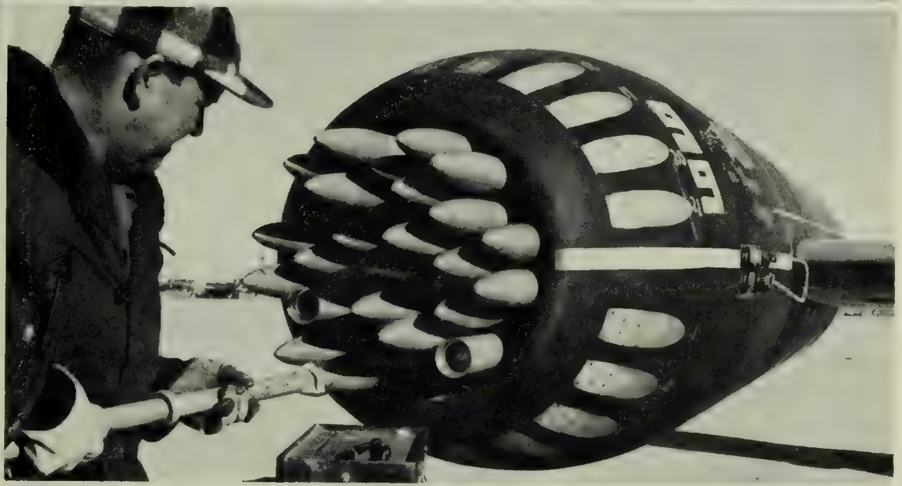
*This could be adapted for F-86 and F-94 aircraft by placing the nosewheel between two rails.*

★ ★ ★

**Foul or Fair** — For flying 3,500,000 accident-free miles, equivalent to 150 trips around the world, the 1st Weather Wing of Air Weather Service and its three reconnaissance squadrons recently received an Air Force Flight Safety Award at Hickam AFB, Hawaii.

The bronze and mahogany plaque was presented to the wing, while each squadron received a trophy in the form of a B-29 model for the total of 17,479 hours flown without an accident in the last six months of 1953.

Flying daily missions over vast areas of ocean in all kinds of weather, these reconnaisssance squadrons help to fill in the otherwise blank spaces



**Above, the range of the F-89D is increased by jettisonable pylon tanks. Right, one of the twin pods is being loaded with 2.75 inch rockets. Each pod carries 52 rockets.**

on northern hemispheric weather maps. Part of their mission includes typhoon reconnaissance, which means penetration of the eye of each reported typhoon in order to forecast its probable path and rate of violence. Nearly 60 such penetrations were made during the period for which the awards were made.

Credited with major responsibility for this fine record is the aggressive flying safety program conducted by the wing headquarters. Every opportunity to utilize modern maintenance methods is realized and repeated emphasis is placed upon all phases of basic flying proficiency.

★ ★ ★

**Bomber Jumps Logs**—To test the strength of the landing gear on a 400,000-pound heavy bomber, the giant plane was run over a series of logs at 90 mph!

Crews reported the aircraft had a "fantastic" appearance as it successfully went through the tests, typical of rigorous investigations given new aeronautical developments for civil and military use.

"The wing center section (almost immediately above the main landing gear) seemed to hump up like a cat confronted by a dog," crewmembers said. "And the wingtips seemed to remain at the same distance from the runway, while the center section humped over every log."

## ODDS and ENDS

- Electrical systems installed in the big transports operated by the nation's airlines contribute much to the efficiency and safety of modern air transportation.

In one late-model transport, the wiring required would stretch over 27 miles. To complete installation in a single plane, 7,224 individual pieces of wire must be used, in addition to 144 electrical wire harnesses and 85 radio harnesses.

- A tiny 50-hp. engine developed by an aircraft company operates at a speed of roughly 40,000 rpm (almost 20 times that of an average auto engine). A gas turbine, it is smaller than a two-foot cube! Among other uses, it serves as an airborne electrical generator.
- In World War I, it took fighter planes an hour to climb to 6000 feet. Today, some jet fighters can reach altitudes greater than 10,000 feet in less than two minutes.
- Engineers in the Measurements Standards Laboratory of an aircraft engine manufacturer daily make measurements to within one-thirtieth of the thickness of a human hair. These engineers have responsibility for the accuracy of master gages, master gears and measuring rods used in engine production.

# the case of the DISCONNECTED PILOT

EVER wonder how much good a G suit really does?

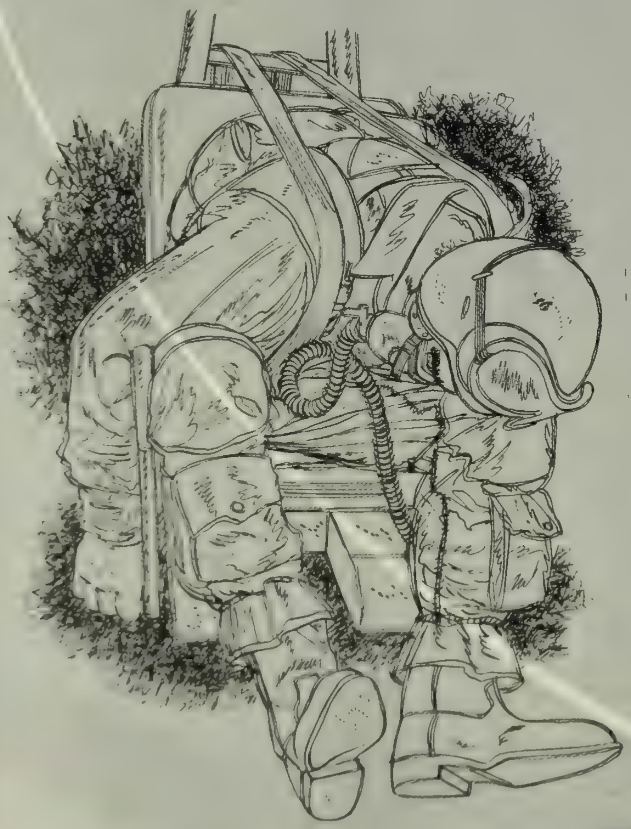
Well, think about this. It is a true story of a real Sad Sack.

Four jet fighters took off on a formation flight. One plane soon aborted because of mechanical difficulty, so it became a formation of three. The instructor led up to altitude, tried a little of this and that, and executed a few turns and maneuvers. He then started a split S maneuver from about 30,000 feet. He pulled a fairly constant $3\frac{1}{2}$ to 4 G and leveled off at about 19,000 feet. He then checked his formation.

*No. 2 man was there; No. 3 man was gone.*

At that particular moment the No. 3 man was in a semiconscious stupor, his hands were off the stick, his head was in his lap, and he was in a steep dive.

Here is what happened. During the split S his G suit became disconnected. However, he continued to follow his flight leader and somewhere in the maneuver began to pull around 5 or $5\frac{1}{2}$ G. Neither he nor any other pilot should have done this. No one can continue to pull that many G very long and remain conscious. This is because human bodies are somewhat like sacks, and under positive G all things movable sag down. Blood, which is most movable, sags into the legs and lower abdomen. Then the brain, deprived of the oxygen which blood carries, soon blacks out. This case was no exception. Through too many G over too long a period, the pilot became, literally, a sad, unconscious sack.



Strangely enough, in this instance unconsciousness helped. When he blacked out, he slumped forward with his head in his lap. When his head was lower, his heart was able to pump more blood to his brain and he began to recover. When he began to recover, he realized that the aircraft was out of control and he tried to reach the stick. However, the G forces were so great that he was hardly able to move. Finally, the G forces let up and he was able to take over.

By that time the crisis had passed. Before he had regained control the plane had gone through the lowest part of its dive and had begun to climb again. The aircraft had been so trimmed that even with an unconscious pilot, the nose gradually raised until it leveled out of the dive, then began to climb. At the lowest part of the dive it had descended to an altitude of about 3000 feet.

This pilot was both fortunate and unfortunate. He was fortunate in the way his aircraft was trimmed. He was unfortunate in having had his G suit become disconnected. And that accidental disconnect points up the real heart of the matter. G suits are important. By exerting pressure on the legs and abdomen they keep pilots from becoming Sad Sacks. Sometimes the suits may be hot and sometimes they may be uncomfortable, but when connected tight and checked right they can be depended upon. One cannot always depend upon having nose-up trim. ●

★ When fastening the G suit hose, listen for a positive click to be sure that the quick-disconnect is seated properly.

★ On initial cockpit check, momentarily depress the button on the G suit pressure regulating valve. This inflates the suit temporarily and serves as a check to insure that the equipment is functioning as it should.

★ Check to see that the regulating valve is set on *Hi* or *Lo*, depending on the mission to be flown.

★

# WELL DONE

LT. ZEAGLER was engaged in a practice night intercept mission in an F-94C. After he shut off the afterburner at 43,000 feet, the engine flamed out. His position was approximately 60 miles north of Philadelphia and he immediately set up a glide back toward the city.

At 20,000 feet an attempted airstart was unsuccessful. Three more attempts were made before the battery failed, rendering the radio, lighting, dive brakes, wing flaps and the intercom between pilot and radar observer, inoperative.

Both heating and pressurization were lost and the instrument panel, canopy and windshield were completely frosted over. Lt. Zeagler wanted to jettison the canopy in order to have better visibility but, since the intercom was inoperative, he was afraid the radar observer would bail out. (The squadron SOP states that any time the canopy is jettisoned during an emergency, the radar observer will immediately eject unless otherwise advised by the pilot.)

His wingman, who had followed Lt. Zeagler down during the letdown, lost contact with him in the rather dense haze and smoke layer over Philadelphia.

With visibility extremely restricted, and without the aid of dive brakes or wing flaps, a flameout traffic pattern was set up over the municipal airport. In spite of the combination of unfavorable conditions, Lt. Zeagler skillfully guided the F-94 to a successful, night flameout landing. ●

★

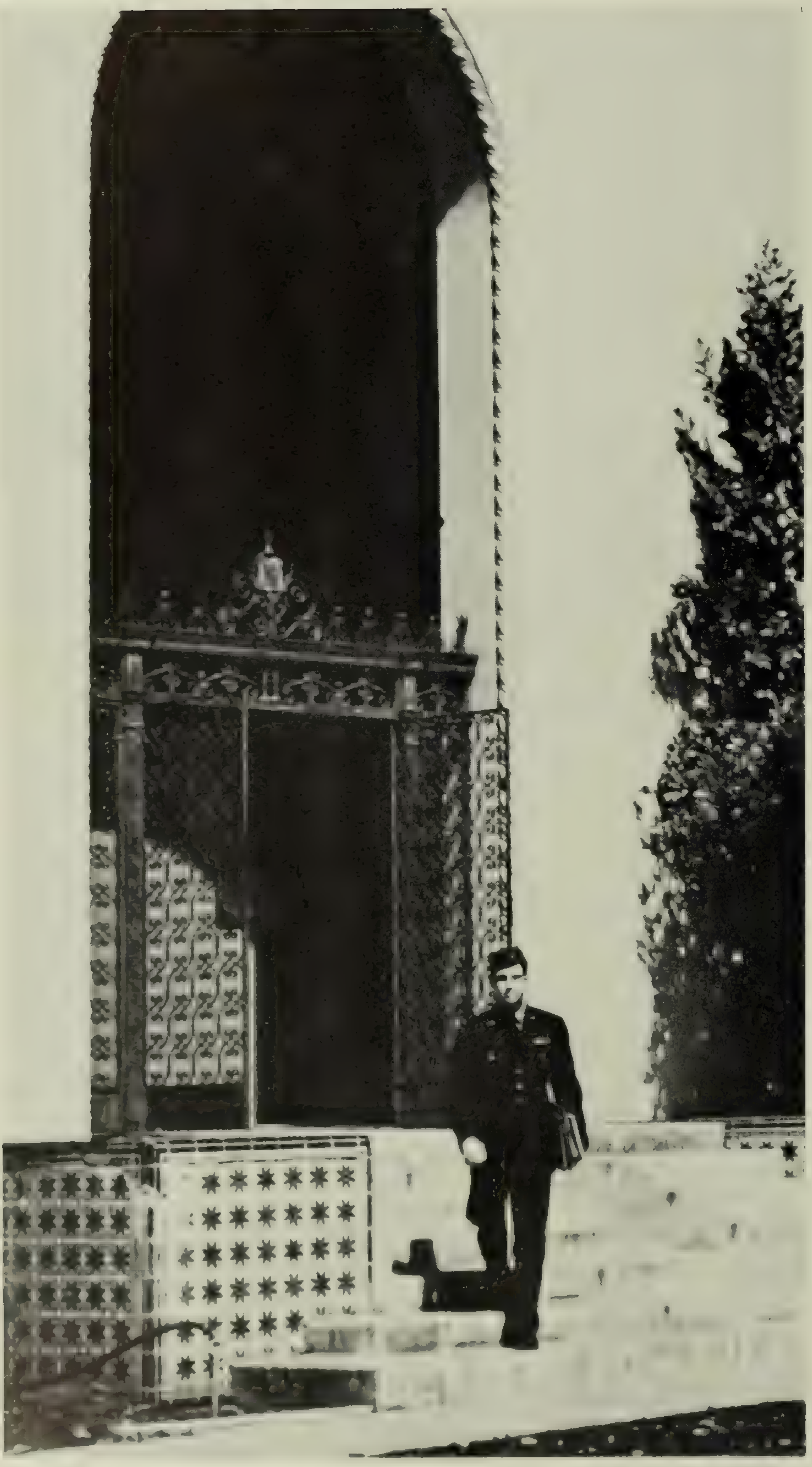
## 1st Lt. Quitman C. Zeagler

**332d FIS, New Castle Co. Arpt. Wilmington, Del.**

# School for Safety

**Maj. Harry E. Dice, Jr., FSO, 7th Bomb Wing, Carswell AFB**

*Reprinted from COMBAT CREW*



Flying safety officers from all over the U. S. Air Force are packing up their bags these days and heading for the University of Southern California to the only school of its kind in the world — a special school for Flight Safety Officers.

Started in March 1953, this unique school has already attracted the attention of the Civil Aeronautics Association and representatives from several foreign governments. An important purpose of the school is instructing flying safety officers on how to impress pilots, crews and maintenance men with a greater realization of the importance of safe practices and also to foster a sense of "flying safety consciousness." This strongly emphasizes a theory SAC has always maintained — that "flying safety is everybody's job."

If anyone thinks the Flight Safety Officers' school is a "rest cure" or a chance to "goof off" and flirt with pretty co-eds, he is badly mistaken. The course is a good one, but also a difficult one, requiring a minimum of two to three hours home study per day to keep up. Classes start at 0800, and there are seven 50-minute periods every weekday. It isn't easy for most students to start back to school and dust off their physics and math and juggle sines, cosines, tangents and complicated formulas that sometimes fill the whole blackboard in the classroom. Seven semester hours of college credit, given for the six-weeks' course, will give you some idea of how intensive it is.

The instructors are all experts in their field and each has prepared his own textbooks especially for this school. The student is allowed to keep his books which form the nucleus for a valuable flying safety library and serve as a source of information for ready reference.

The 212 school hours are broken down as follows:

| | |
|---|---|
| Aeronautical Engineering | 72 hours |
| Accident Investigation & Prevention | 67 hours |
| Aviation Physiology | 18 hours |

| | |
|---|---|
| Psychology of Flight | 18 hours |
| Educational Principles | 18 hours |
| Field Trips | 14 hours |
| Centrifuge | 2 hours |

The aeronautical engineering portion of the school is the most difficult — but also the most interesting. It starts off easily enough with a brief review of algebra, physics and trigonometry, and then rapidly gets into the theory of flight, high-speed aerodynamics, stability and control and strength of metals and aircraft structures. The engineering portion of the course is extremely valuable to all pilots, not just flight safety officers. Basic fundamentals reviewed include: Bernouli's equation, lift-drag ratio, aspect ratio and power required vs. power available.

Instructor Harry H. Hart, B. S., makes the section on high-speed aerodynamics most interesting. The study of Mach. effects, critical Mach. and effects of sweep-back on compressibility and ultra-sonic heating takes two weeks. This is an important part of the course, because, as aircraft get faster and faster and the Air Force converts more and more to jets, even bomber pilots must learn about supersonic flight. Stability and control, especially at high speed were studied and considerable time was devoted to the discussion of tuck-under and pitch-up encountered while going through the trans-sonic speed range. The advantages of such innovations as completely irreversible controls, flying tails and wing tip ailerons used to prevent wing tip torsion, which causes aileron reversal at high speeds, were brought out.

The last two weeks of the engineering class are devoted to the study of stress analysis of various metals used in aircraft construction. Torsion forces, compression forces, and shear forces on steel, 24ST and 25ST aluminum are discussed. One whole day is spent in the lab where stress machines actually measure the forces necessary and demonstrate the type break caused by the failure of brittle and ductile materials. In the case of an aircraft accident involving materiel failure, this knowledge is most valuable in determining whether the break was caused by a design deficiency, overstress on the part or metal fatigue failure.

The physiology class is taught by Dr. Paul Evans, former Air Force flight surgeon who is now resident physician at Los Angeles County Hospital. His informative lectures and discussions deal with the role of aviation physiology in flight safety. Roughly 65 per cent of all USAF aircraft accidents can be attributed directly to human error. Of these, 12 per cent can be attributed to mental and physical stresses, such as hypoxia, fatigue, high G loads in maneuvers and carbon monoxide. It is necessary for the crewmember to adapt successfully to the constantly changing environment of flight if accidents are to be prevented. This adaptation is largely accomplished by the use of such complicated personal equipment as oxygen masks, pressure suits, bailout bottles and exposure suits. As the airplane has long since outstripped the adaptability of man without these aids, knowledge of their proper use is essential to the safety of all who fly.

One Saturday morning during the course each student is scheduled to ride in the human centrifuge. This device looks for all the world like a freak ride in an amusement park

**Students sit in on daily world-wide accident briefing conducted at Norton AFB by Brig. Gen. Richard J. O'Keefe, Director of Flight Safety Research.**

DIRECTORATE OF FLIGHT SAFETY RESEARCH

or an overgrown see-saw that goes 'round and 'round instead of up and down. It consists of a long beam, pivoted in the center with a seat suspended at one end and a counterweight on the other end. By controlling the speed of rotation, it is possible to apply a constant radical acceleration or G force on the subject.

The cockpit is equipped with a standard aircraft seat with safety belt and shoulder harness, but in spite of its familiar appearance it does little to quell the feelings of apprehension experienced by everyone the first time he rides in the gadget.

A system of red and white signal lights on the panel, operated by push switches held in the right hand, indicates to the operator the condition of the subject. This is necessary, because human tolerance to G forces will vary tremendously from one person to another, or even in the same person from one day to the next.

One student in the class passed out at 3½ G, whereas one other — a fighter pilot accustomed to high acceleration forces — could function perfectly at 7 G. The average pilot, however, can withstand about 3½ to 4 G before grey-out, black-out or pass-out occurs.

Since the brain is an organ that weighs only one-fiftieth of the total body weight but requires one-fourth of all the oxygen used, it is apparent that it will suffer most from a lack of oxygen-carrying blood. The eyes, too, require large amounts of oxygen, and this is why dim-out or grey-out occurs first when the heart is unable to supply blood to the head because of adverse G forces.

Black-out is caused at slightly higher G forces and is a condition where the subject is still conscious but unable to function because of restricted vision. Pass-out, or complete unconsciousness, generally occurs at about .7 more acceleration force than black-out. When this happens, the subject is completely incapacitated. Even after the G forces are removed, it generally takes an appreciable length of time — say 10 to 15 seconds — to fully regain consciousness.

The anti-G suit was also used on the centrifuge runs. This suit is very effective. It is most impressive that the subject can remain fully conscious and alert even while subjected to two more G than that which caused black-out on a previous run without the suit.

With the development of high speed and high altitude airplanes designed to withstand large aerodynamic forces, the problem of human tolerance to acceleration has become extremely important. It behooves each pilot to learn as much about this problem as he can.

Psychology of flight is a relatively new term, but it, too, has its place in aircraft accident prevention. This class is taught by Dr. Neil Warren, another former flight surgeon, who helped develop the famous stanine tests. Doctor Warren has conducted numerous studies for the Air Force and is currently engaged in a project to devise an index of accident exposure. His plan would give different weights to various types of flying. For example, an hour in a fighter is considered more dangerous than an hour in a transport. The plan may produce a more realistic accident rate scoring system.

The class was taught that in the analysis of human error accidents psychological factors are often found to be the underlying cause. The purpose here being to teach the accident investigator not only to look for what caused the accident but *why* it was caused. For example, a pilot lands wheels-up and causes a major accident. The accident is written up as pilot error, and that's the end of it. The real question is — Why did the pilot forget to lower the gear? Did he have something else on his mind, trouble at home, a sick child or financial worries?

However, the most important application of this subject to the safety of flight is felt in the field of human engineering. This term is defined as designing and building a machine (aircraft) to fit the individual rather than trying to make the individual conform to the machine. One example of the application of this theory is the cockpit standardization program. It is now recognized that forcing an individual to change a certain fixed habit pattern by non-standard location of controls and switches is definitely a hazard to safety of flight.

When United Nations troops entered the compounds from which South Korea had released the prisoners, they found many still inside. This only serves to illustrate that there is always someone who never gets the word. That is why *Educational Principles and Methods* is another subject offered at the school. It is taught by Dr. Louis Kaplan, who emphasizes the role of the flying safety officer as an educator in putting across the flying safety programs and campaigns. The course includes public speaking, how to organize and conduct a meeting, graphic presentation and press relations.

The importance of press relations is illustrated by the story of the small plane which crashed in a farmer's field. No one was injured, and the news would probably have rated only a small paragraph in the local newspapers. However the story ended up on the front page all over the country with much unfavorable publicity, because the military guard at the wreckage got into a fight with the newspaper photographer and smashed his camera because he took a picture.

Mr. Frank G. Andrews, formerly assigned to the Directorate of Flight Safety Research at Norton Air Force Base, conducts the class in Accident Prevention and Investigation. Air Force Regulation 62-14 and Air Force Manual 62-5, the basic guides for the accident investigator, are covered in great detail. The formation of a sound pre-accident plan is discussed and illustrated and the student is taught its advantages.

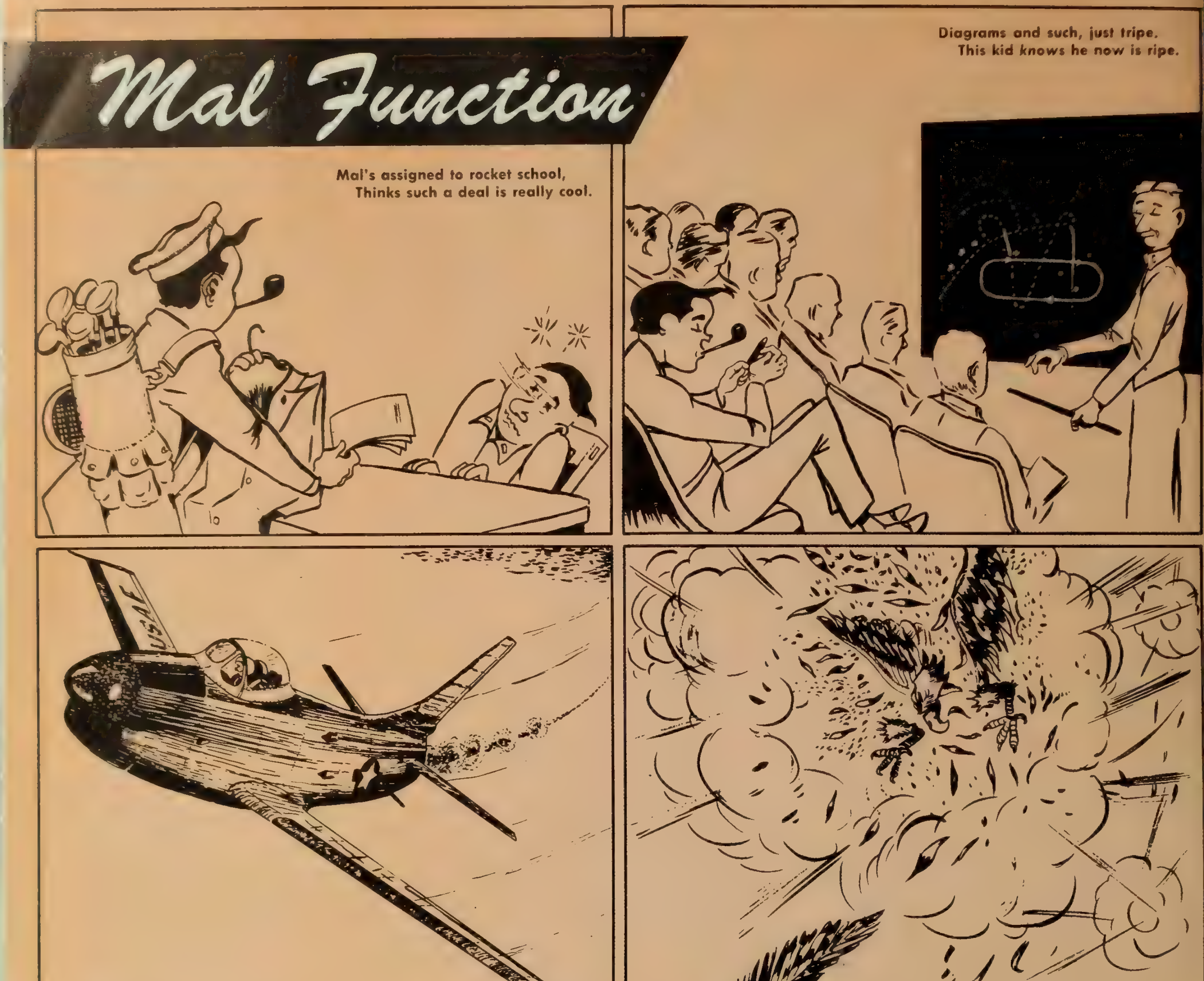
The accident prevention portion of the class is by far the most important phase of the school, for it is here that the information learned in all the other classes is put to actual use. The accident prevention programs carried out by the various Air Force commands, sub-commands, and at base, wing and squadron level are fully discussed. By a free exchange of ideas, and by studying methods previously proved successful, the prospective flying safety officer is taught how to set up a program to fit the needs of his organization.

The value of the school should become more and more evident in a reduced Air Force accident rate as its graduates return to their units and apply the knowledge and principles learned. The cost of the school is mighty cheap insurance for the millions invested in pilots and crews and equipment. The needless loss of life and property caused by preventable aircraft accidents can and must be reduced. The preservation of our combat potential by training men at this school to become specialists in aircraft accident prevention is certainly worthwhile. It is considered a valuable contribution to the security of our nation and the peace of the free world everywhere. ●

# DON'T TABLE THOSE REPORTS

On page 18 of this issue we have presented a few hairy tales sent in by pilots who wished to share their experiences — and mistakes. By publishing these reports we move a little closer to attaining an important USAF objective — elimination of all avoidable aircraft accidents. So far, this year shows progress, with an all time record low in July.

# Mal Function



Mal's assigned to rocket school,
Thinks such a deal is really cool.

Diagrams and such, just tripe.
This kid knows he now is ripe.

Mal locks-on to king-size eagle,
Believes this pass is strictly legal.

Fires before he gets the word,
This is end of one large bird.

Irate chase pilot quite upset,
Has a hunch Mal is no-bet.

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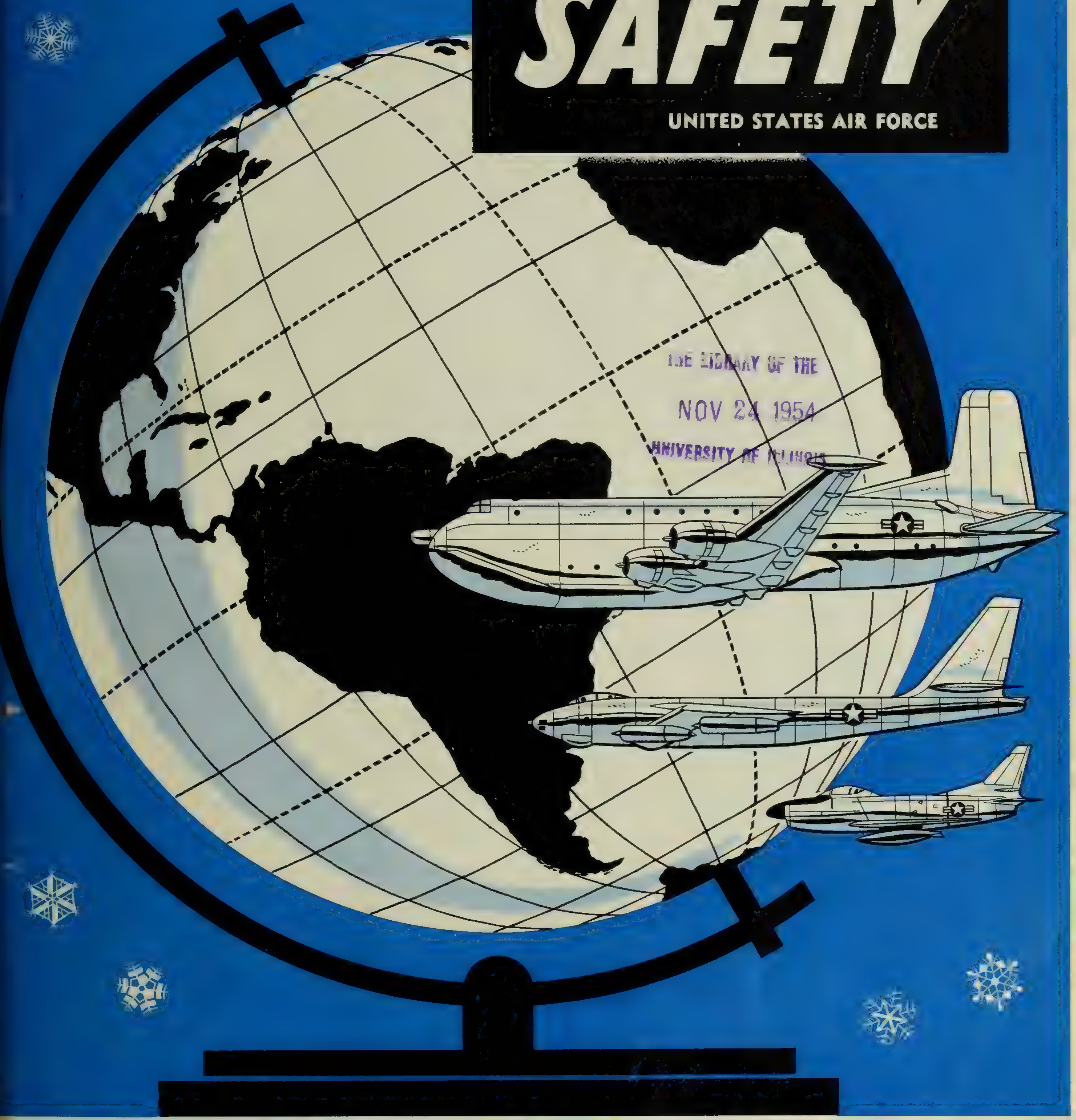
OCTOBER 1954

# FLYING SAFETY

UNITED STATES AIR FORCE



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**WINTER ISSUE**

*World Wide Weather . . . . . page 2*

# FLYING SAFETY

VOLUME TEN NUMBER TEN

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We are hunting good photos to use in the magazine. Look in your files and see if you can come up with anything good on winter scenes, survival or aircraft (either airborne or ground) and send them in to us.

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### SUBSCRIPTIONS

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The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payment can be made for manuscripts submitted for publication in FLYING SAFETY magazine. Contributions are welcome as are comments and criticisms. Address all correspondence to the Editor, FLYING SAFETY magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Non-Air Force organizations must query the Editor before reprinting, indicating how the material will be used. The contents of this magazine are informational and should not be construed as regulations, Technical Orders or directives unless so stated.

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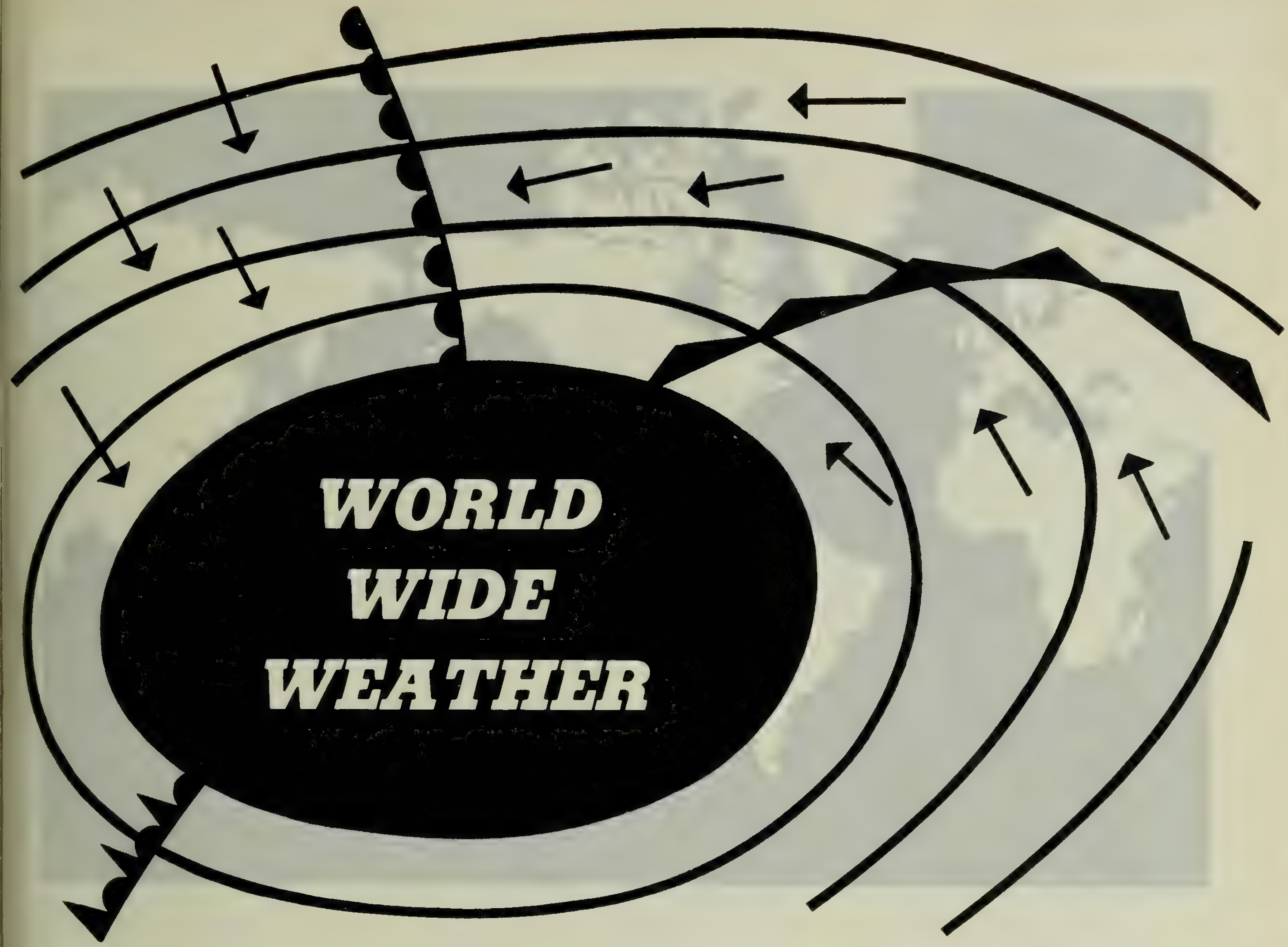


# WORLD WIDE WEATHER

MANY jokes, good and bad, have been made about the weather and the prediction of same. Usually the weather forecaster becomes the object of such witticisms.

Nevertheless, much can be gained by peering into the future for what is likely to be happening in the areas through which you fly as far as ice, snow, fog and other characteristics of winter are concerned.

Every pilot should be able to read a weather map. These maps display much information in a pictorial manner and a brief survey of one, guided by a forecaster, will show in a few moments things it would take hours to describe.

Not every pilot can become an expert at forecasting weather, but each should know some of the principles that the weatherman uses to arrive at the forecast. Then, the pilot will know the limitation of the forecast as well as build confidence in his own decisions on the safest and most efficient method of flying difficult weather.

In arriving at such decisions, the pilot should get and keep in mind a complete picture of the current weather situation; move the picture forward in space and time to cover the route of the flight, and consider the changes that will occur during the time in flight. If the forecast interval is short (three to six hours), it is often possible to use past history to determine the amount of weather motion that will take place.

In addition to reading the weather forecasts, a sharp pilot will study the synoptic situation on the weather map noting especially the frontal weather where the most dangerous icing usually is found. Only two factors are necessary for icing — temperatures near or below freezing and the presence of moisture. However, the rate of ice accretion depends on the size of the water drops.

Usually, heavier turbulence is found in conjunction with cold fronts, while freezing rain is most often found in the cold air under the warm front. If possible, a pilot should avoid flying through water clouds above the freezing level.

On teletype sequences the freezing level for each station making radiosonde observations is easily found. This level is added to the individual sequence as part of the remarks and may be written as RAFRZ 134MSL RH 92. This would read "radiosonde freezing level 13,400 feet Mean Sea Level, Relative Humidity 92 per cent." In this example, in addition to the height of the zero isotherm, the probability of clouds at this level is shown by the high relative humidity; a high humidity means probable cloudiness and a low humidity means clear skies.

With the change of air masses associated with frontal passages over various stations or in flying through a front, the freezing level may change radically within a short period of time or over a short distance. Usually, this may be checked by finding the freezing level within each air mass

Fog results in severe restriction to visibility and reaches its maximum during the winter months.

over stations and considering the past movement of fronts and the approximate point at which the aircraft will fly out of one air mass and then into another.

Although low ceilings and visibilities over the country can be forecast, a pilot still should study the weather maps and sequences of the area in which he will be flying. Two conditions ordinarily cause most of the low ceilings and reduction in visibility. One is the presence of a slow-moving, warm or occluded front with precipitation ahead of it. This often will cause zero-zero conditions to prevail over a large area. This condition then builds up over a long period and will be found becoming progressively worse on successive weather maps and sequences.

Advection fog is the second such condition. This fog is formed when moist air moves over a colder surface, or when air is lifted by prevailing winds up the slopes of mountains. It may persist during the day, but usually will become low stratus with ceilings of 100 feet to 500 feet. With sufficient heating it may break in the afternoon and form again about sunset. Forecasting this formation and dissipation may be tricky and pilots should be sure of an alternate which will remain open before flying into a questionable area.

Radiation fog also should be expected on clear nights with light winds but usually is more localized than the above conditions.

Another danger is the effect on a pressure altimeter caused by flights into an area where there is a pressure or temperature deviation.

When flying from higher pressures into lower pressures or into colder air the altimeter will read higher than the aircraft's actual altitude.

It is possible to forecast, in general terms, the type of weather that will take place in any given area for any given month. By doing this pilots can get some idea of what to expect when flying in that area at that time. For purposes of this discussion the ZI is divided into five sections: The Northeast, Southeast, Middle West, Northwest and Southwest.

## THE NORTHEAST

OCTOBER, when the frost is on the pumpkin as they say, is associated with increasingly frequent outbreaks of continental polar air from north and central Canada. Waves develop on the polar fronts and move northeastward along the Atlantic coast and cause fog and precipitation along the coastal states. Frequently these disturbances will cause low ceilings and visibilities for as long as 48 hours. It is well to remember that regardless of the cause (either a wave or a high pressure system) winds with easterly components generally result in overcast and rain or drizzle conditions since they cause advection of moist air from the sea.

October is the worst month of the year relative to ground fog formation in the sunrise period. A combination radiation-advection fog also is fairly prominent during the fall season in the New Jersey-Long Island areas between midnight and the hour after sunrise. Fog in the La Guardia-Mitchell vicinity usually is accompanied by a slight wind from the SSW or SW.

As a result of cold front passages in the northeast section, the weather conditions generally improve rapidly with visibilities of six miles or more. But approaching warm fronts or warm frontal passages often produce ceilings and visibilities of less than one mile. Icing conditions do not occur until late in the winter season.

A common occurrence during winter proper is the "northeaster," a storm with typical warm frontal characteristics that persists for two to three days. The wind blows steadily from the east or northeast and precipitation is continuous in the form of drizzle or wet snow. Clouds are usually very low.

## THE SOUTHEAST

THE major percentage of adverse weather conditions that affect the southeast during the winter months is due to the formations of thunderstorms in the western Gulf of Mexico and southeastern Texas. Late October and all of November mark the beginning of the penetration of continental polar air, but by the time it reaches this area the air is modified to the extent that cold frontal passages are infrequent.

Flying restrictions develop with the passage of weak cold fronts which become stationary through Alabama, Georgia and the Carolinas. Consequently, waves develop along the front, producing low ceilings and visibilities for several days. During the winter season, an average of 25 cold fronts pass through this area with poor flying conditions existing 12 to 24 hours before the frontal passage and 4 to 6 hours afterward.

Wave formations originating in this area or in southeastern Texas produce the poorest flying weather for the longest period of time — two to three days. This type of situation covers an extensive area leaving only a few, scattered air terminals open. The poor weather is very general and finding an alternate is almost impossible. Although the greatest hazards are fog and low stratus, through the mountainous sections, icing presents a serious problem to all aircraft.

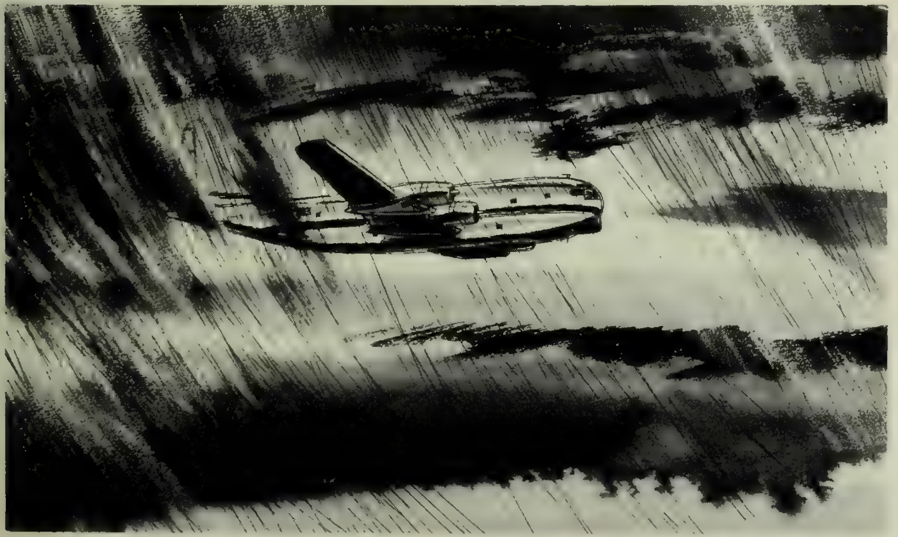
## THE MIDDLE WEST

FALL in the Middle West is the season when there is a pronounced increase in frequency and regularity of weather fronts as opposed to the summer season. The marked change occurs during late October or early November. Precipitation becomes more common and low ceilings and poor visibilities predominate in the area. This combines to create the poorest flying weather in the ZI at this time, with the Great Lakes region normally exposed to the highest frequency of fog and low ceilings.

The chief cause of low ceilings and rain is a low pressure system or frontal wave in southeastern or southwestern Kansas with resultant over running warm, moist tropical air. In October a polar high pressure system brings bad weather to the eastern side. The air blowing over the Lakes becomes unstable and this instability occasionally is strong enough to set off small thunderstorms. After October, icing presents a hazard to flying as the average height of the freezing level is about 9000 feet over the Alleghenies. Conditions are favorable for lightning strikes on IFR flights through these squall conditions.

In the Plains States, October brings a few cold fronts, one or two active lows and a tendency toward ground fog formations during the sunrise period. The average freezing level lowers to about 12,000 feet.

In the Midwest, the chief cause of low ceilings and rain is a low pressure system or frontal wave.



## THE NORTHWEST

IN this region October and early November usually usher in the first real foul weather of the season. The Pacific high pressure cell, which throughout the summer produces the major weather influence, retreats to a more southern position. This occurs in conjunction with the penetration of colder polar air from the Aleutian low pressure system. This polar air, with accompanying troughs, is characterized by fronts, low clouds, poor visibility and precipitation. The peak of intensity of this condition usually is reached in late December and early January. These frequent penetrations produce many days of ceilings and visibilities below minimum VFR flight conditions. The abundance of precipitation enhances the importance of pilots being alert to restricted windshield visibility and to the problem of wet, slippery runways.

The probability of low level icing increases as the average freezing level lowers to 8000 feet MSL. Even though the passage of fronts, usually occlusions, means improving weather, quite often in this area post-frontal fog forms. This is particularly significant in the northwest coastal areas. Over the northwest mountain ranges turbulence and icing, associated with the production of cumulus clouds due to forced lift and frontal lift, are often severe and should be avoided.

## THE SOUTHWEST

IN the extreme southwestern area the rainy season becomes established by early November with total rainfall about double that of October. However, the frequency of rain is low compared with the eastern part of the country. On the whole, the California coast has a high percentage of fog and low ceilings during this period. The San Francisco bay area has a sharp increase in fog and at Los Angeles the frequency of fog is almost equal to that of December, the worst month of the year.

The Las Vegas region generally has fine weather during autumn, but the rest of the plateau region is exposed to the first winter types of frontal and air-mass weather. Average height of the freezing level is down to about 8500 in the northern section and 10,000 in the southern section which puts most flights in the icing zone. The most persistent foul weather in mid-winter usually is found in the interior valleys of California. Better flying weather prevails around the east slope of the Rockies due to the prevalence of strong downslope winds from westerly quadrants.

★

*Much valuable information also can be learned of the weather in other parts of the world in which USAF aircraft are operated. Too often pilots fly into these areas without even a general knowledge of the weather. Capt. Gerald Breen, AWS, prepared the following breakdown of weather outside the Z. I.*

## ALASKA

THE greater portion of this vast area possesses a climate as favorable as that of many portions of the United States. It is true though that some parts of the area, such as the Aleutian chain and the tundra region north of the Brooks Range, have a very unfavorable aspect. The temperature regime through Alaska varies widely. Although Alaska covers a number of northern latitudes, and it would be expected that temperatures would be much lower in the north than in the south, this latitudinal effect is overcome by other temperature-controlling processes in some areas. In winter, when incoming heat from the sun is minimized and most of it is reflected by snow cover, the ground continues to radiate heat to space, resulting in very low temperatures. The lowest and highest temperatures occur in the interior.

The southern coastal area from Ketchikan to Attu has a mild and humid climate with abundant precipitation in winter. On the adjacent mountain slopes, heavy snowfalls are quite frequent. Throughout the high coastal region, winter temperatures are unusually warm for these high latitudes. On the other hand, as a result of occasional polar continental outbreaks, minimum temperatures of 5 to —5 degrees F. sometimes occur along the continental coast line. Cloudiness is predominant and fogs are quite frequent.

There is a rapid northward decrease of temperature along the west coast of Alaska. The low-lying coastal region from 60 degrees N to Mackenzie Bay on the Arctic Ocean is a region of cold arctic winters. The prevailing easterly winds result in frequent invasions of cold continental polar air across the west coast, which produce low temperatures. Over the northern section of Alaska, cold air masses are generally present throughout the year. The winter precipitation minimum near Barrow is consistent with the presence of a cold high-pressure center.

The climate of the interior of Alaska is characterized by extremely cold winters. The high coastal mountains generally prevent the invasion of maritime polar air masses at ground level. Radiational cooling during the long winter nights produces very low surface temperatures, while at upper levels, warmer temperatures prevail.

**High coastal mountains often act as barriers to the invasion of moist, cloud-forming air masses. Alaska and the Northwest are typical areas where cloudiness prevails west of the high mountains.**

## JAPAN

JAPAN experiences a climate that is dominated by the Asiatic monsoons. The climate is one of many contrasts — contrasts between the north and south, between the Sea of Japan and the Pacific coasts of the main islands of Japan and between the coastal plains, lowlands and the mountainous terrain.

The winter monsoon develops as a large northerly current of continental polar air on the east side of the main Asiatic high-pressure system. The full winter monsoon persists steadily for days, and it usually moderates slowly in strength. During this period, the weather is cloudy or overcast with occasional rainshowers or light rain in the vicinity of the polar front, and longer periods of light or moderate snow and rain over the sea of Japan and the main islands of Japan, especially over the windward or Japan Sea slopes of northern Honshu and Hokkaido.

Precipitation is common during all months of the year throughout Japan. Seasonal maxima, however, in amount of precipitation are found in winter along the coastal plains and mountain slopes of northern Honshu that face the Sea of Japan. Much of the precipitation that falls over the main islands of Japan during winter and spring is in the form of snow, especially over Hokkaido and northern Honshu. The lowest temperatures are likewise experienced in winter.

Highest wind speeds are generally reported in the winter. However, winds of greater force may be experienced during the passage of typhoons in summer and autumn than during other seasons.

## KOREA

THE climate of Korea is quite variable, being controlled largely by its peninsular nature and by its location between the world's largest land mass and seas contiguous with the world's largest body of water.

Although the prevailing flow of air during the winter is from the north, the actual direction of the monsoon varies between northwest and north-northeast. The slightly modified polar continental air mass produces almost cloudless days and low temperatures. Often the passage of an intense cold front may bring snow or rain, especially early in the season, but more often has no pronounced weather other than gusty, northerly winds and occasionally dust or sandstorms.

The monsoon is generally strong, with wind speeds exceeding gale force for some hours after the front has passed. However, it soon moderates, and nighttime temperatures are extremely low. In the interior of Korea, temperatures often fall below 0° F.

## PHILIPPINE ISLANDS

THE climate of the Philippines is primarily maritime, characterized by heavy showers, high humidity, light winds and high temperatures. Lower temperatures are experienced in the mountains and highlands, and along the immediate coasts during the day when sea breezes predominate. Typhoons occasionally interrupt the climatic monotony. They normally bring continuous rains, lower temperatures and higher wind speeds which are locally destructive and often cause tidal waves.

From November through early March the Philippine Islands are influenced by a northeasterly air stream, composed of air originating over the cold interior of the Asiatic mainland. The cold air periodically surges westward onto the warmer Pacific, where it is warmed and humidified. Much of the moisture is deposited on the northward and eastward-facing slopes of the various mountain ranges, while regions to the west of these mountains have a distinct dry season. February is the month of maximum development of the northeast monsoon.

In a similar way, cloudiness, humidity and temperatures vary across the Philippines during the winter. Thus, on the windward or eastern slopes, cloudiness is abundant, humidities are fairly high and temperatures are comparatively low. On the western slopes, cloudiness reaches its annual maximum, humidities are lowest and temperatures range from cool at night to hot during the day. The influence of the northeast flow decreases southward and is rarely felt in the southern portions of Mindanao Island.

## ARABIAN PENINSULA

THE climate of the Arabian Peninsula is dry and hot. Average annual rainfall is less than 5 inches, except in some of the highland areas. Temperatures are moderate in winter. Only the northern and eastern parts of the peninsula normally are affected by frontal systems associated with extratropical disturbances. These disturbances are most frequent in winter, when three or four a month affect the area. Cloudy skies, rain and sometimes thunderstorms are associated with frontal passages.

In winter, afternoon temperatures in the coastal areas are normally between the middle 60's and middle 80's; nighttime temperatures range from about 50 to 70 degrees F. Relative humidity is high throughout the year at coastal locations.

Surface wind directions are variable, being diverted by local topography. Wind speeds are generally low. However, strong winds often accompany fronts and cause extensive dust storms, especially in the interior regions.

Cloudiness is, in general, most extensive in the colder months, except over the central and eastern part of the south coast.

## NORTH AFRICA

DURING the winter months, the land area north of the Equator is subjected to cooling in contrast to thermal heating south of the Equator. The cooling results in the formation of a ridge of high pressure across North Africa. The frontal systems that traverse the Mediterranean Sea cause a large variation in the day-to-day weather of the Mediterranean coast and the mountainous regions behind the coast. Southern Morocco and the desert regions to the south of the Atlas Mountains are much less susceptible to these influences, and consequently the daily weather is much more stable.

Winter temperatures along both the Atlantic and Mediterranean coastal regions are mild, and freezing temperatures are infrequent. Wintertime precipitation shows a large variation from one region to another. However, precipitation amounts generally decrease from north to south almost everywhere. For the most part, moderate amounts of precipitation fall on the coastal plains and plateaus of northern Morocco, on the more northerly portions of the Atlantic-facing slopes of the Atlas Mountains and on the Mediterranean coast and the adjacent seaward slopes of the mountains between Tangier and Tunis. At some exposed coastal and mountain localities in northeastern Algeria and northwestern Tunisia, precipitation amounts are often large. At low elevations, all of the winter precipitation occurs as rain, but with increasing elevation, snowfall becomes progressively more common, and at high elevations in the Great Atlas Mountains the snow cover is persistent.

There is considerable cloudiness on the Mediterranean coast between Tangier and Tunis, on the seaward slopes of the mountains facing the

Mediterranean and, to a lesser degree, farther southward. Most of the cold-season cloudiness is of the cumuliform type. This cloudiness is associated mainly with cold frontal and post cold frontal activity.

Frontal thunderstorms occur during the colder months of the year. Air operations are hampered to a great extent by these frontal thunderstorms since they usually are extensive and are not easily circumnavigated.

Northern Africa is susceptible to the formation of the "sirocco," an excessively hot, dry and often dusty wind which blows from the desert toward the coasts. The minimum frequency of this type of wind is encountered in winter. The chief characteristic of the sirocco is its dryness; there may be considerable dust when the sirocco is strong, but the dust does not usually occur in dense, black clouds. Local sandstorms of varying intensities frequently occur, being largely influenced by the nature of the local ground surface. During such storms, visibility may fall to 200 yards, but it is usually variable with periodic improvements.

## SPAIN

THE Iberian Peninsula is large enough to develop a likeness to a continental climate. In winter, because of the cold, there is high atmospheric pressure with outflowing winds. The Meseta of central Spain is different in many respects from the coasts. The winters are far colder inland than on the coasts. Long spells of frost with temperatures as low as 15° F. are not uncommon. In the mountains and plains, traffic is often seriously impeded by snowstorms. The high pressures of winter check the ingress of the rainstorms of that season, so that February is not much rainier than July.

The north coast of Spain has a west European coastal climate, with warm winters and equitable temperatures and heavy rainfall, usually more than 50 inches a year. The south and southeast coasts are sheltered by the Sierra Nevada. The rainfall is small (maximum in November). During the winter, the west coast is very mild, with a small temperature range, damp air and abundant rain.

## FRANCE

THE major airflow over France is part of the circulation around the semi-permanent North Atlantic or Azores high, the center of which migrates roughly between latitudes 25 degrees N and 40 degrees N throughout the year. During winter the Azores high is weaker and is displaced southward, while relatively high pressure prevails over the continent and lows frequently move eastward over the Mediterranean. This type of pressure distribution results in frequent southwesterly winds over the western lowlands, northwest and north winds over the interior highlands and more variable winds over the Mediterranean coast.

Cold continental air from northeastern Europe or warm, continental air from northern Africa may occasionally cover much of the country during the winter season. However, maritime air masses are experienced about five times as often as continental air.

In the western lowlands of France the winters are, on the whole, quite mild, particularly near the coasts. Temperatures decrease from south to north and from the coasts inland. Very low temperatures may occur with a strong flow of air from the east. Relative humidities are high at the coasts, with a general decrease inland. Cloudiness is extensive throughout the region, with slight diurnal variation. Precipitation amounts are greatest on the coasts and decrease toward the interior of the country. Precipitation falls on more than half of the days, except in the northeastern part; the frequencies generally decreasing from north to south and from the coast inland. Snow falls on relatively few days and a snow cover is infrequent. Fog is frequent at many places in the region.

Temperatures are somewhat lower in the interior highlands of France, except at the higher elevations where they are normally below freezing all of the time. Snowfall here is more common than it is farther west. It is most frequent at the high levels, where a lasting snow cover is established. Cloudiness is extensive, with a slight diurnal variation. Fogs are common, particularly at exposed mountain stations.

Temperatures are highest in the region of the Mediterranean coast. Snow falls on only a few days. This is the least cloudy region of France, and fog occurs on one or two days a month in winter.

## ENGLAND

BEGINNING in October, temperatures in the United Kingdom steadily decline. By November, readings below freezing are occasionally present, with snow occurring on one or two days in the northeast portion of Britain. Averages of relative humidity become fairly high in all sections. With an increase in the relative humidity, cloud bases gradually lower and stratus cloudiness predominates.

Low-pressure centers which reach the British Isles from the western North Atlantic are responsible for the prevalence of the southwesterly wind. The air masses reaching the British Isles in winter normally have a long overwater trajectory. Surface temperatures are therefore rarely below 32 degrees F. when the air first reaches the coast, but as the air moves across the higher terrain, rain and snowshowers are common occurrences. When the flow of air ceases, skies generally clear and temperatures frequently drop below 32 degrees F. at night. Lowest temperatures are recorded during the period of stagnation following an outbreak of cold air from the north or northeast.

Winter is the season of highest relative humidity, except along the immediate coasts where values remain high throughout the year. Fog and cloudiness also reach a maximum during the winter.

## GERMANY

DURING the winter there are many storms migrating in from the Atlantic affecting Germany with extensive cloudiness, poor visibilities, strong winds and mild temperatures. Occasional outbreaks of cold air from the east result in very cold weather, sometimes for extended periods. Northern and central Germany lie within a region of predominant airflow from the west. This region, subject to the winds from the Atlantic, has relatively equitable temperatures in both winter and summer. Southern Germany, including the northern slopes of the Alps, has greater temperature fluctuations because of the stronger continental influence.

The frequency of frontal activity increases slowly throughout winter and is at a maximum in February and March. Frontal activity usually ranges from 5 to 22 days per month, averaging about 13 days in December and 16 days in February. Northern Germany has a greater frequency of frontal activity than the southern portion. In winter the cloud structures normally are not as high as in summer and turbulence or thunderstorms do not occur as frequently.

During December and January in particular, a mean cloud cover of 77 per cent is observed. Most of this cloudiness is of the low stratus variety. The cloudiest regions of Germany are the western slopes of those mountains in the north and northwest that are open to both the southwesterly winds of winter and the more northwesterly winds of summer.

Most of Germany receives an annual precipitation ranging from 20 to 35 inches, about half of this falling in winter, much of it in the form of snow. This is especially true in the east, the south and in the mountain ranges of central Germany.

Daytime winter temperatures generally fluctuate between 25 degrees and 35 degrees F., and slightly higher in the coastal regions. Very low winter temperatures occur occasionally in connection with invasions of cold air masses from the east. Most of the fog occurring in Germany is of the radiation type, and for this reason is at a maximum in the early morning hours during the season.

Germany lies in a region of rather well-developed westerly circulation. Considerable variation in this westerly flow can occur however, in connection with any particular weather situation. Strongest winds are observed during winter. In January, Germany becomes a zone of prevailing southwesterly winds. Occasional gales occur, usually in connection with frontal squalls.

## GREENLAND

GREENLAND consists almost entirely of a high plateau with occasional peaks extending above 10,000 feet. The elevation favors the presence of cold, dry air masses. Strong downslope winds are observed along the periphery of the country. Topographical factors cause decided local variations in wind force and direction. The high plateau prohibits the passage of pronounced frontal systems across Greenland. Consequently, frontal precipitation is slight over the interior. The high land mass favors lower surface temperatures than over the neighboring low-lying regions, such as the Arctic Ocean. Even though Greenland is principally south of latitude 80 degrees N, northern Greenland is colder than the North Pole.

Winter is the stormiest season, characterized by considerable cloud cover, poor visibility in precipitation and fog, local gale winds and turbulence in the lowest layers near the surface, and icing in clouds.

Gale winds which, in general, occur most frequently during this season, vary considerably in frequency from one locality to another, being closely associated with topographic features. Daylight in winter varies from a short duration in the extreme south to none at all for a period of two months in the extreme north.

Lows, or storms in the general circulation accompanied by much cloudiness and precipitation, are frequent on both the eastern and western coasts. They also start on the southern tip of Greenland, and then usually move up along either coast. These storms are most intense during the winter months.

## THE CARIBBEAN REGION

THE climate of this region is distinctly tropical and the dominant control is the northeast trade wind system. In general, excellent flying conditions prevail, but some serious hazards exist. These are the hurricanes of autumn, winter storms from the north and thunderstorms in all seasons. During the colder months, occasional outbreaks of cold air travel southward and cover all or parts of the Caribbean. In some instances, the pilot will encounter a line of thunderstorms associated with this condition.

*The greatest danger to flight is presented by tropical storms, sometimes of hurricane intensity, which occur from June through December, mainly in September and October.* Seven or eight hurricanes are observed in an average season. Hurricanes are accompanied by winds over 75 miles per hour, heavy rainfall, widespread cloudiness, low ceilings and poor visibility.

Cumulus clouds are the most prevalent type in this region, although stratus clouds sometimes occur, most of them associated with the winter storms. Occasionally a well-developed thunderstorm cloud may cover the entire sky.

Although the prevailing wind direction is easterly, other directions are encountered in winter when storms move southward over the region. Temperatures are remarkably uniform, resulting from the domination of the trades and the small variations of the sea-surface temperature. Precipitation is plentiful at all locations. There are generally two periods of maximum rainfall, the first occurring in May or June and the second in September, October or November. Very heavy rains occur frequently, and torrential rains sometimes accompany tropical storms.

*This article presents the world-wide weather picture. But remember, check that weather before you go.* ●

It's best to know the symptoms and the Dash One procedures for your aircraft because

# ICE is where you find it

UPON return from the mission a jet penetration was made from 20,000 feet. There were three layers of clouds between 20,000 feet and 1700 feet that the jet fighter had to pass through. The lower layer was approximately 2500 feet thick, with icing conditions prevailing. The aircraft was flown on final approach at a speed of 150 knots, was slowed to 140 knots over the end of the runway and on the round out for landing the aircraft stalled at 135 knots, while still approximately eight to ten feet in the air. Normal touchdown is 120-125 knots.

The aircraft dropped in on the right main gear, but was brought under control by the pilot and the landing roll completed. The hard landing broke a hydraulic line to the wheels causing the loss of brakes. The aircraft completed the roll approximately 7650 feet down the runway. The leading edge of the wing had a layer of rime ice ⅜ of an inch thick, and the vertical fin and horizontal stabilizer were covered to a depth of ½ inch. The ice had coated approximately four inches of the underside of the wing from the leading edge, aft.

Without becoming academic and just to refresh memories on ice producing conditions, let's review some fundamentals that apply in the foregoing accident.

Ice forms when two conditions exist. Moisture in liquid form must be present in the air and the effective temperature must be freezing or lower. All clouds contain moisture in one form or another so icing can be expected if the temperature is at or below freezing. In fact, light ice or frost forms when an aircraft flies from a cold area that has reduced the temperature of the airplane itself to freezing, into a saturated cloud where the temperature is above freezing.

Super-cooled water droplets can exist in the atmosphere as a liquid at temperatures of —35°C. to —40°C. These droplets do not freeze because of the surface tension of the drop, its salt content, and most important, the liquid is undisturbed. Once it is disturbed or broken, as when it strikes an airplane, it turns into ice.

The very fine moisture particles (which form at about —10°C. and below) are the kind that formed the rime ice on the jet described above.

In its purest form, it is found generally in stable weather conditions where vertical atmosphere motion is restricted. Such conditions are typified by the stratus type clouds through which the jet let down.

It tends to conform more closely to an airfoil section than does clear ice. The weight of rime per unit is less than clear ice; however, the danger lies in the added drag or the disfiguration of the airfoil.

Clear ice is formed from large, super-cooled water droplets and is most likely to form at temperatures from —0°C. to about —10°C. It is tenacious, harder and smoother and is more difficult for de-icer boots to remove once it has built up. At times it has a roughened appearance but it is never granular. Remember this when attempting to distinguish the nature of your super cargo. Actually, most structural ice is a mixture of rime and clear.

The airflow about the plane has little effect upon the pattern that clear ice will assume. It usually builds forward from the leading edge of the wing and has a pronounced effect on the aerodynamics of the airfoil.

Clear ice usually starts forming

Above, care should be taken to remove all ice and snow from the wings prior to taking off. Left, ice on the leading edge of the wing on this fighter caused a premature stall during landing.

by closely following the wing contour as does rime, but if allowed to go unchecked it builds forward in a blunt, unstreamlined mass. It piles up quickly and has forced aircraft down in as little as 10 minutes after beginning to form.

The main effect of wing ice is to disturb the normal airflow about the wing. This results in loss of lift, in varying degrees, and increases the drag. Basically, it is the shape rather than the weight of ice that is the troublemaker. A half-inch of clear ice on a C-54 will increase the gross weight by approximately 6500 pounds, yet fuel consumption increases only 20 gallons an hour. However, what that extra 6500 pounds of surplus weight does to stalling speed is something to think about.

Four factors govern the rate of ice build-up: the amount of super-cooled water present, the temperature of the air, the area and roughness of the surface exposed and the airspeed of the aircraft.

The first of these factors can be estimated in flight by the darkness of clouds encountered and their vertical development. Sharpness of the contour of clouds indicate active build-up and consequently larger amounts of water vapor in the air. In stratus clouds the lower levels contain the most moisture.

One should remember that under normal conditions the lower the air temperature, the less relative amount of water present. However, one should also remember that as long as moisture is present there is a possibility of ice forming.

Any rough surface over which air flows not only cuts down aerodynamic cleanliness of the plane, but also becomes an anchoring point for ice. Rough paint, rivet heads and frost particles are especially bad. Frost is unquestionably the worst of the offenders, as ice forms on this base almost immediately.

Speed versus amount of ice accumulation is a highly controversial subject. This much is known however, the rate of accumulation is always higher at higher airspeeds, but the amount of accumulation may be greater at slower speeds.

Although it is usually impossible to see the empennage from the cockpit, it may be safely assumed that if ice is observed on the leading edge of the wing it is also forming on the tail surfaces. As you'd expect, ice on the horizontal and vertical stabilizers results in a tendency to yaw.

Proper use of de-icer boots demands an understanding of their capabilities and limitations. Ice that does not cover two or more of the parallel tubes in the boot should be left alone. It will not be sufficient to cause serious consequences, and if the boots are turned on only a part of the ice is likely to be broken loose. The chunks that remain not only destroy the airfoil more than the original formation, but act as a rough base for additional ice to adhere to and build up unevenly.

Since rime ice usually forms on the wing leading edge, the aerodynamic efficiency of the wing is not greatly impaired. And, because it is granular in make-up, you stand a better chance of its breaking off in large chunks when the boots are employed, if you allow it to build up properly. The strength of the boots generally will handle considerable rime satisfactorily, provided not too much clear ice is mixed with it to strengthen its cohesive qualities.

Much more care must be taken when clear ice forms on the wing. It is highly tenacious and it must be broken before it reaches a strength that the boot cannot break. If corrective action is taken too soon, the ice will merely crack along the line between the inflated and deflated sections of the de-icer and will not break off. Experience shows that about one-eighth of an inch to one-quarter of an inch is the correct thickness to begin boot operation. It is better to begin too soon than too late. Once ice is thick enough to make the boot inoperative, you are at its mercy.

If either clear or rime ice is encountered for a short time only and you are certain you will be in clear air soon, leave it alone. Use the boots after you are through the icing area to break up all that will come off and let evaporation clean up the rest of the wing for you. Fly manually through icing and move the control surfaces from time to time if the air is smooth to prevent them from freezing at the hinges.

Prior to takeoff, remove snow, frost, sleet and any other foreign particles that have frozen to the aircraft. Never be satisfied with less than an aerodynamically clean plane. Wing covers are available at most cold weather bases, and ten minutes taken to put them on may save many hours of trying to de-ice the plane. Do not warm up where slush and moisture can be picked up by the props and thrown back over the wings and tail surfaces of the aircraft.

In landing with ice, make wide shallow turns, turn the de-icers off and *maintain plenty of airspeed.*

**Ten minutes spent to put on wing covers can save many hours of work later, removing ice and snow.**

### Propeller Icing

Propeller ice reduces the efficiency of the prop, reduces airspeed and, in turn, usually demands increased fuel consumption. When ice forms only on one or two of the blades the resulting vibration can reach disastrous proportions. Although it normally forms on all blades at the same time, quite often it breaks free from one blade. And the shake-up is terrific. Prop ice is likely at any time wing ice is picked up.

A propeller rarely ices its entire length. Slower RPM is more conducive to icing, but at normal cruising RPM, one-half to two-thirds of the length of the blade is as far as icing will extend. Even this amount of ice is serious and the wise pilot takes preventive measures before entering known ice areas.

Propeller anti-icers should be turned on prior to entering icing areas. The blades should be thoroughly coated with fluid, after which the flow should be reduced to about two quarts per hour, per prop. The trick is to use just enough to keep the blades clean and not exhaust the supply needlessly.

At night it is often difficult to determine if propeller ice is forming except by falling back on the old flashlight. Throw the light beam on the whirling disk near the hub. Spinning circular streaks will indicate that ice is forming. It's a fairly sure bet that if ice is forming on the spinner, it is building up on the blades also.

Icing on props is indicated sometimes by engine vibration and loss of airspeed resulting from decreased propeller efficiency. If prop ice catches you unawares and de-ice fluid has no effect, increase and decrease RPM several times, then use fluid to keep the blades clean.

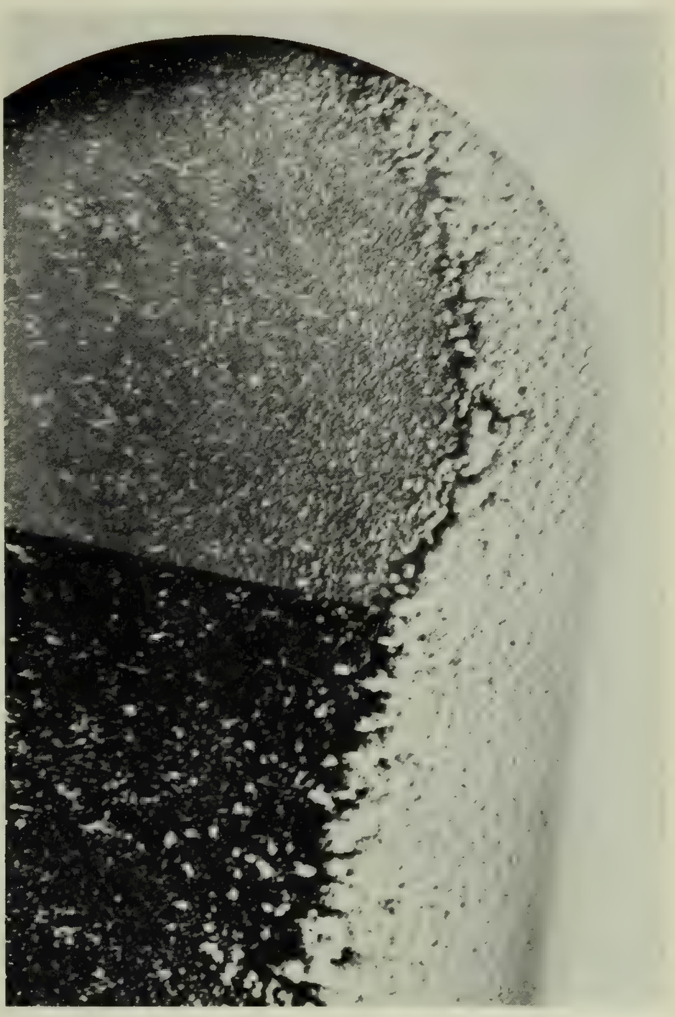
Pitot tube icing is extremely dangerous since it causes inaccurate readings of the pitot system instruments. It is the easiest to combat, however. The heating element in the pitot tube is sufficient to melt ice under the most adverse conditions and should be used whenever visible moisture is present.

Radio antenna icing can be serious and is relatively hard to prevent. It causes the mast to vibrate and the wires to sag and sometimes break under the increased weight.

Ice bridging over the insulators thus grounding the antenna to the plane's structure, can cut off all communication. The only remedy is to change altitude and find a warmer layer of air where the ice will melt. Sometimes it is possible (but not very practical) to melt ice from the antenna by holding the transmitter key down and setting up enough induced current to do the job.

Windshield ice can be tolerated

If ice forms on spinner, it probably is forming on the prop blades.



Propeller icing, as shown above, often will result in severe vibration.

until landing time. From then on forward vision is imperative. Many windshield de-icing systems are employed, and all work to a degree. In addition, most non-jet aircraft have side windows that may be opened when all other means of forward visibility fail.

### Carburetor Ice

Air at 18°C. and 100 per cent relative humidity contains 11.2 pounds of water vapor per 1000 pounds of air. Air at 0°C. and 100 per cent relative humidity contains 3.8 pounds of water vapor per 1000 pounds of dry air. Thus, if air at 18°C. and 100 per cent humidity is cooled in the carburetor to 0°C., the moisture in excess of 3.8 pounds per 1000 pounds is condensed out as free water and at this temperature it will freeze.

To give you a practical idea of the quantities involved, a C-124, powered by four Pratt and Whitney engines and cruising at 1700 brake horsepower, consumes approximately 60,000 pounds of air per hour. Under these conditions, over 100 pounds of free water passes through each engine every hour.

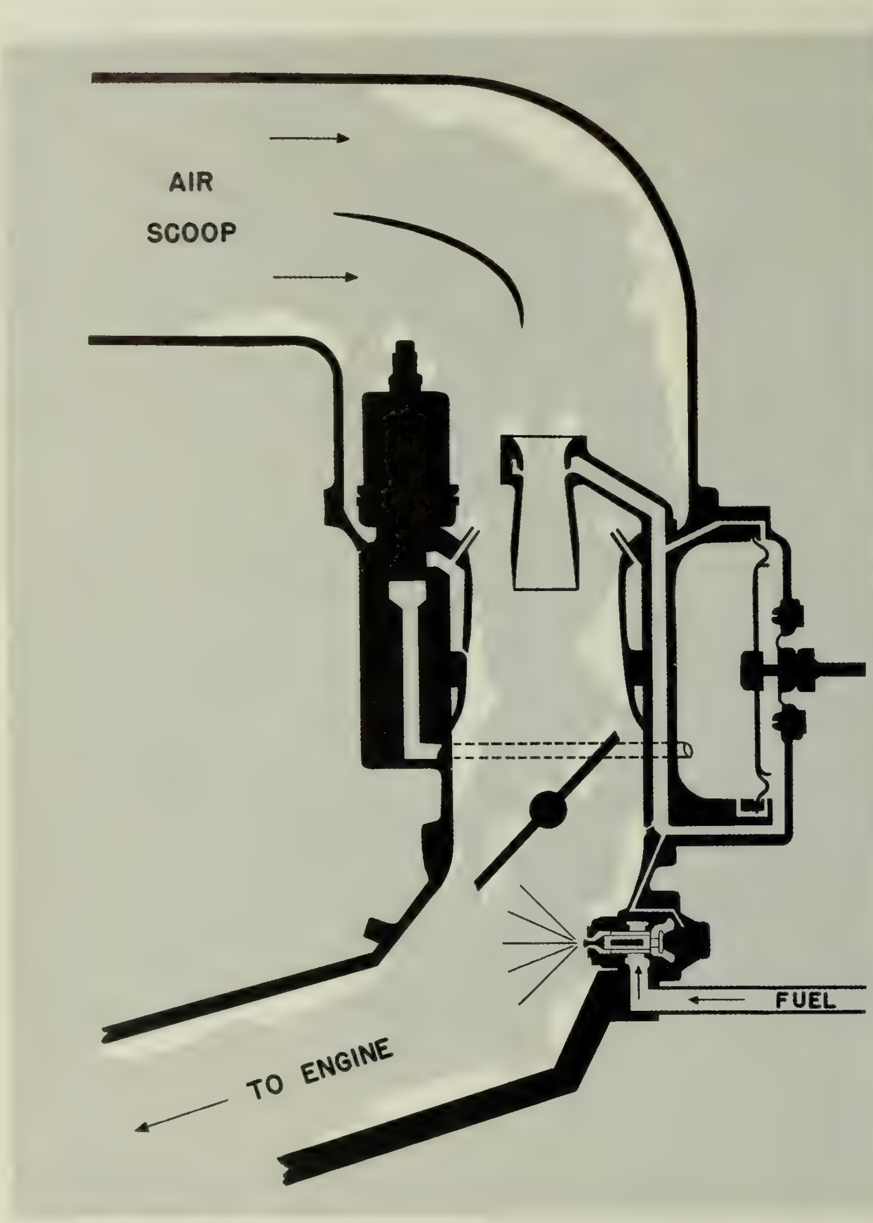
Ice may be formed in the reciprocating-engine inductions system by these processes:

- *Impact Ice*—formed when supercooled water strikes a surface that is at sub-freezing temperature. It collects on scoop inlets, duct walls, carburetor-inlet screens, exposed metering elements and other protuberances in the induction system. These ice formations may reduce the airflow and thereby reduce the engine power. In addition, the ice formation upsets the carburetor metering by disturbing the airflow pattern.
- *Throttle Ice* — formed because of the cooling effect of the fuel evaporating after it is introduced into the airstream. This ice probably occurs most frequently in actual operation because it may form at carburetor air temperatures considerably above 0°C.

Experiments with carburetors have shown fuel-evaporation icing at inlet-air temperatures as high as 39°C., indicating a tremendous local temperature reduction.

Most of the heat necessary to evaporate the fuel is taken from the air, which causes it to drop in temperature. Ice may affect airflow by blocking off the supercharger entrance, affect fuel-air ratio by interfering with the fuel flow and affect mixture distribution or quantity of mixture to individual cylinders by upsetting the fuel flow at the fuel nozzle distributor or airflow distribution at the supercharger entrance. Under certain conditions of high humidity, this ice may form with carburetor air temperatures as high as 28°C.

Float-type carburetors, which mix fuel with the air within the venturi, cause fuel evaporation to occur dur-



**Carburetor ice can occur under a wide range of temperatures and can result in complete engine failure. Ice forming can disturb the airflow and upset the fuel metering process.**

ing the throttling process and make the throttle region especially critical to icing. Pressure-type carburetors, which incorporate a fuel nozzle located in close proximity to a wake-producing protuberance, have been observed to cause eddying of the fuel spray in sufficient quantity to cause ice formation on the protuberances. Butterfly-type throttles or fuel nozzles mounted on a central web are particularly susceptible to the effects of fuel recirculation.

How can you detect carburetor ice? It depends on the type of carburetor-engine combination, the location of the ice and the supplemental equipment used on the installation. Airplanes flying at a constant pressure altitude and throttle setting, may experience an airflow loss due to blocking by ice formations resulting in *reduced manifold pressure.* A torquemeter also serves notice of power loss because of ice. Engines with fixed pitch props show power loss from icing by reduced engine speed. Icing on fuel metering parts is indicated by a change in fuel flow, if a flowmeter is installed, and also by engine surging, roughness, backfiring and, in extreme cases, engine stoppage. At reduced power or idling it is frequently impossible to operate the engine if the metering parts of the carburetor are iced up.

For engines equipped with automatic manifold-pressure regulators, the presence of ice in the air passage may not be known until the throttle is in the wide-open position unless a throttle-position indicator is used.

Carburetor icing is probably the most insidious form of aircraft icing. It can occur under a wide range of temperatures and can result in complete engine failure. As previously noted, carburetor icing can occur when the atmospheric temperature is relatively or fairly high although generally it is encountered only between 13° and 18°C., when accompanied by a high relative humidity, rain or overcast. Below 13°C., the danger of ice formation in the air is slight. However, once the ice begins to form in the carburetor, the power can be seriously affected in less than a minutes time.

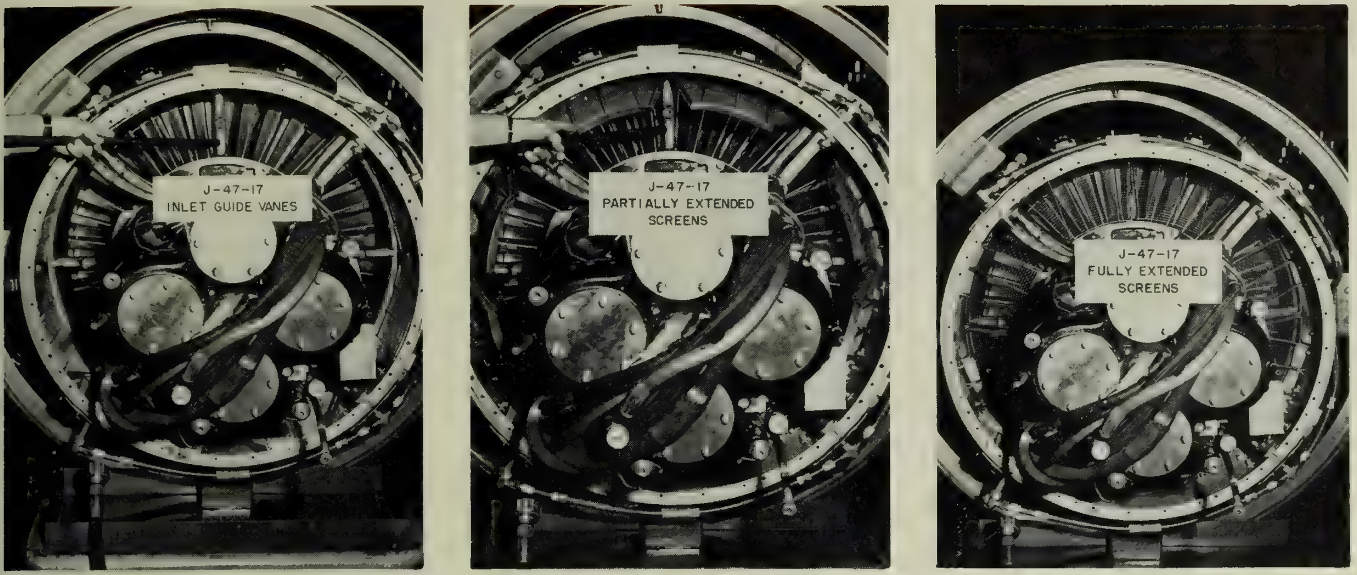
The carburetor in performing its function of metering fuel and air induces the following changes in the fuel and intake air which contribute to the refrigeration of the moisture:

- Vaporization of the liquid fuel.
- Changes in intake air and mixture velocity and consequently a pressure change.
- Evaporation of moisture present in the intake air.

Of all these factors, the vaporization of fuel contributes the greatest by far to the refrigeration of the mixture and is always present, regardless of atmospheric conditions with respect to moisture. The vaporization of the fuel requires heat, and this must come from the intake air. The temperature drop due to vaporization of fuel may be as much as 15°C. Thus, even in summer operations the temperature in the carburetor at the throat, throttle or the adapter can be 0°C. or lower, and, if at the same time the atmosphere has a relatively high humidity or if the flight is through clouds or rain, an ice formation will occur.

The phenomenon of icing in rain or overcast conditions is less surprising than the icing that can occur in clear skies and high relative humidity.

Whenever icing is suspected, preventative action should be taken at once. Apply full carburetor heat for about one or two minutes, then after moving the control to the full cold position, see if the manifold pressure returns to the same value as before.



**Ice forms on the fixed or extended inlet screen and compressor inlet guide vanes resulting in loss of thrust and a rapid rise of tailpipe temperature.**

If it shows a higher reading than previously, you had ice.

If ice has formed and heat is not sufficient to melt it off, the induction system de-icing alcohol will usually do the trick. Alcohol should be used only to remove ice, as small quantities of alcohol aggravates icing due to the temperature drop caused by the vaporization of the alcohol. If heat is used properly and in time, the icing has to be rather severe before it is necessary to use alcohol.

One final warning concerning the use of carburetor heat: The amount of moisture in the air affects the ability of the carburetor heat control to effect a given rise in temperature. The higher the moisture content, the harder it is to raise the temperature. This is important to know when flying through heavy precipitation.

Also, if icing is encountered, move the carburetor heat control a few times to prevent the door from freezing in any one position.

### Jet Engine Icing

Centrifugal compressor type jet engines, such as the J-33 and J-48 are relatively free from icing difficulties. While it is possible for these two types to ice up under extreme conditions, such cases are rare. Axial flow power plants, on the other hand, are seriously affected by icing.

The initial indication of jet engine icing is increased exhaust gas (tailpipe) temperatures. This is all too often the only indication prior to complete engine failure.

Ice forms on the fixed or extended inlet screens and compressor inlet guide vanes (stator) and restricts the flow of inlet air. This causes a loss of thrust and a rapid rise in tailpipe temperatures. As the airflow decreases, the fuel-air ratio increases, which in turn raises the temperature of the gases going into the turbine. The fuel control attempts to correct any loss in engine rpm by adding more fuel, aggravating the condition.

Complete turbine failure may occur in a matter of seconds after ice builds up in the engine air inlet. Critical ice build-up on the inlet screen can occur in less than one minute under severe conditions.

The idea that heating due to ram pressure at high speed will prevent icing is erroneous. The heat generated at subsonic speed is insufficient to prevent ice formation.

Serious inlet duct icing can occur without the formation of structural ice, and it is necessary to understand what causes this type of icing in order to anticipate it. When jet aircraft fly at velocities below approximately 250 knots TAS and at high power settings, the intake air is sucked, instead of rammed into the compressor inlet. This suction causes a decrease of air temperature (adiabatic cooling). Under these conditions, air at an ambient temperature above freezing may be reduced to subfreezing as it enters the engine.

The maximum temperature drop which can occur in most jet engines is approximately 5°C. The greatest temperature drop occurs at high rpm on the ground and decreases with (1) decreasing engine rpm and (2) increasing airspeed.

In sub-freezing temperatures, the rate of engine icing remains fairly constant up to approximately 250 knots TAS. Above 250 knots the rate of icing increases rapidly. It takes no genius to see that a reduction of airspeed will reduce the rate of engine icing under these conditions.

Because engine icing forms at such a rapid rate, speed in getting the engine anti-icing system into operation is essential. On takeoff and landing, under icing conditions, place the anti-icing system into operation first. (Of course, the procedures differ with aircraft type, and the Dash-One will give you the info on *your* particular type of aircraft.

The old school solution, "avoid known areas of icing conditions" still applies. Many areas of probable icing conditions can be avoided by careful flight planning.

If icing is encountered, immediate action should be taken to get the engine anti-icing system into operation, change altitude or vary course to avoid clouds, reduce airspeed when in freezing air and reduce engine rpm as necessary to prevent any excessive tailpipe temperatures.

The majority of jet icing difficulties are encountered below 6000 feet. But let's face it, ICE IS WHERE YOU FIND IT. Know the symptoms, know your Dash-One procedures, and you're all set. ●

# Winter Weather Hazards

Weather Maps Prepared by Air Weather Service

IN CASE you haven't realized it, you are going to wake up one of these mornings and find winter isn't just around the corner, it's HERE. In order to help you to be prepared better for its foul antics, a rundown on how winter weather flying affects our accident rate appears in order.

Throughout the years there has been a general decrease in major accident rates. The entire Air Force team deserves a hearty pat on the back for this continuing rate reduction. However, let's not assume that winter weather is no longer a serious hazard to flight just because the rates for winter months keep decreasing.

To establish the facts and to determine the extent of seasonal influences, data covering an extensive period were subjected to recognized procedures of statistical analysis by The Directorate of Flight Safety Research. The findings definitely indicate that patterns of seasonal variation exist in accident frequency.

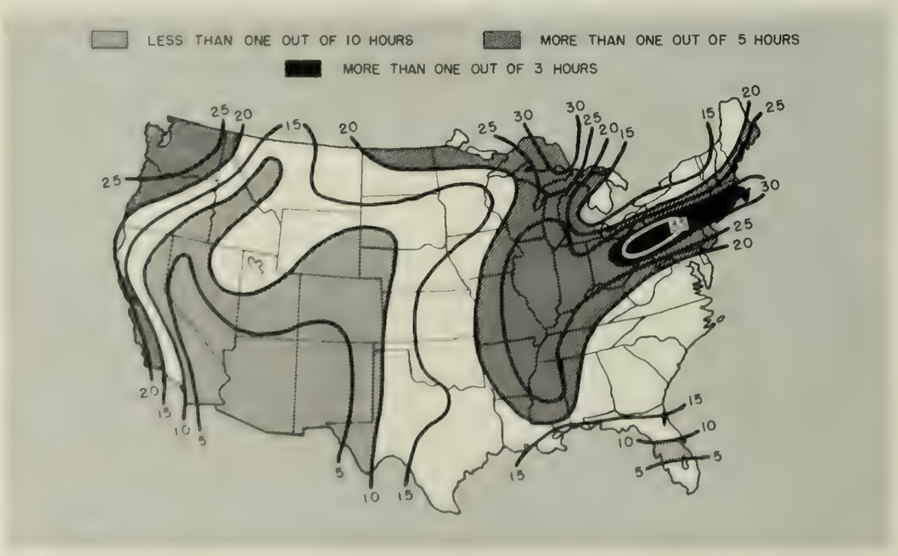
The thing we're attempting to point up is that weather is a factor to be considered during the winter months. The charts show that weatherwise the ZI has been carefully plotted. Although these curves represent averages, they should assist somewhat in flight planning.

Over a period of seven years a total of 246 aircraft were involved in major accidents in the U. S., in which weather was a contributing factor, as shown in Chart I. Boil that down to yearly averages and you come up with 35.14 accidents per year (you may find it hard to reconcile .14, but that's the way it comes out). You'll note from the chart that the majority of accidents have occurred during the winter months.

In the final analysis the weather accident *potential* is greater during the December-April period. Winter weather phenomena that contribute to accidents vary, of course, with geographical locations. The charts make this very clear.

Knowing what parts of the country are most affected by fog, rain, snow or low ceilings is of considerable value for flight planning purposes. Naturally, you'll consult the weather forecaster before leaping off, and if his current weather charts are at variance with the *averages* reproduced here, don't be surprised. ●

Frequency of ceilings of 1000 feet or less, forward visibilities of three statute miles or less.


LESS THAN ONE OUT OF 10 HOURS
MORE THAN ONE OUT OF 5 HOURS
MORE THAN ONE OUT OF 3 HOURS
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20
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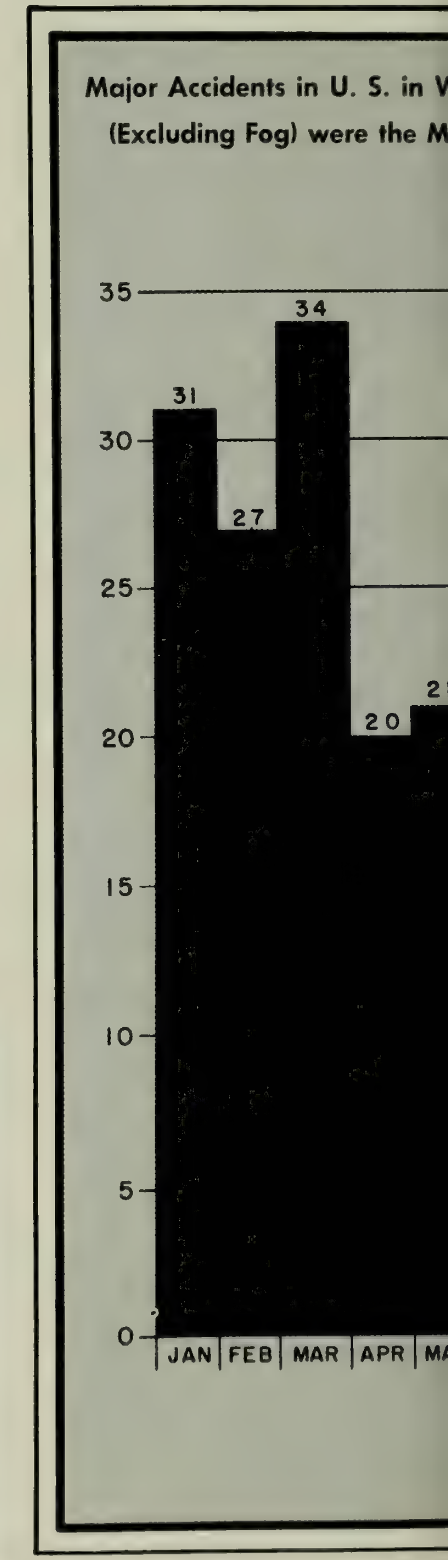
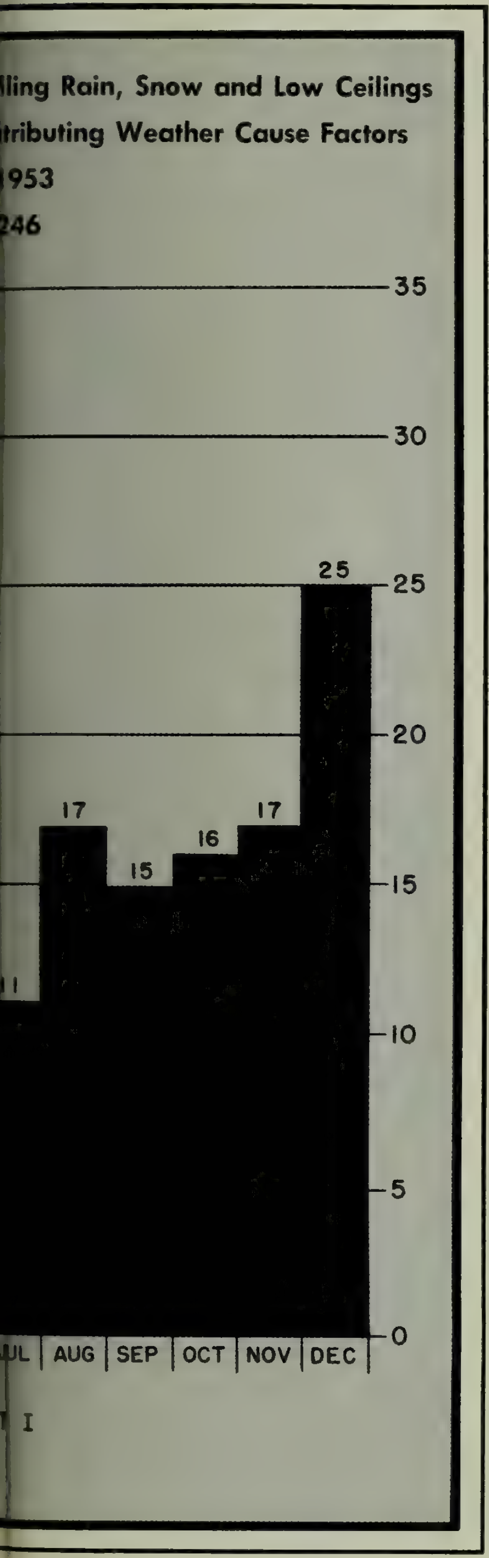
10
5
30



**In the wintertime, snow, rain, fog, low ceilings and restricted visibility all gang up on the unsuspecting pilot. Here is a graphic presentation of winter weather flying hazards.**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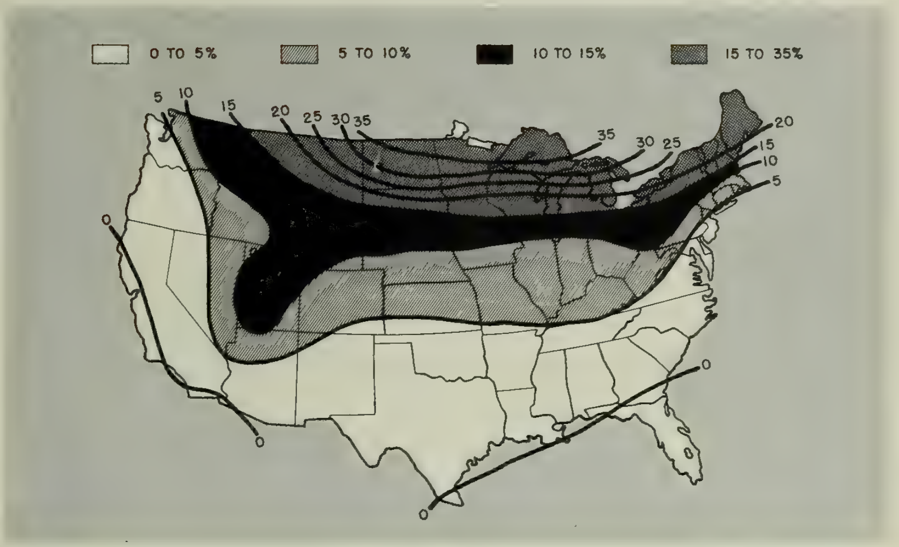
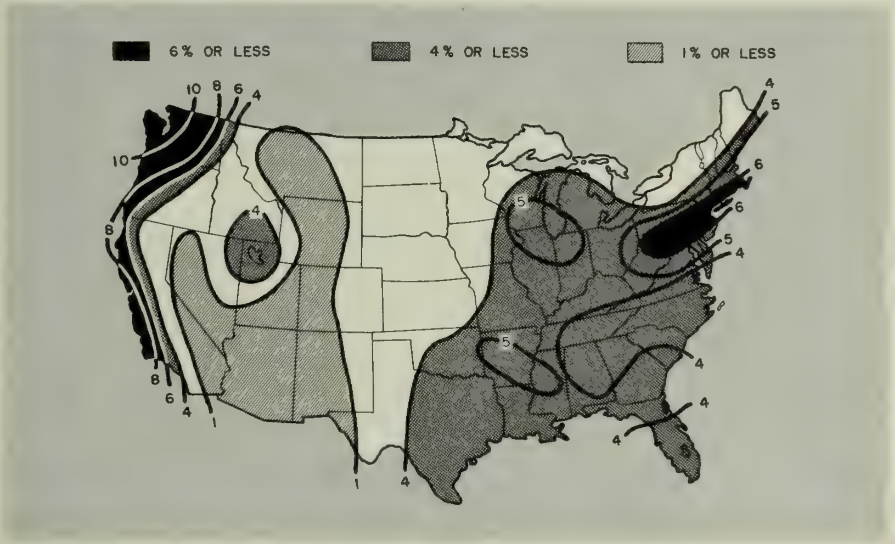
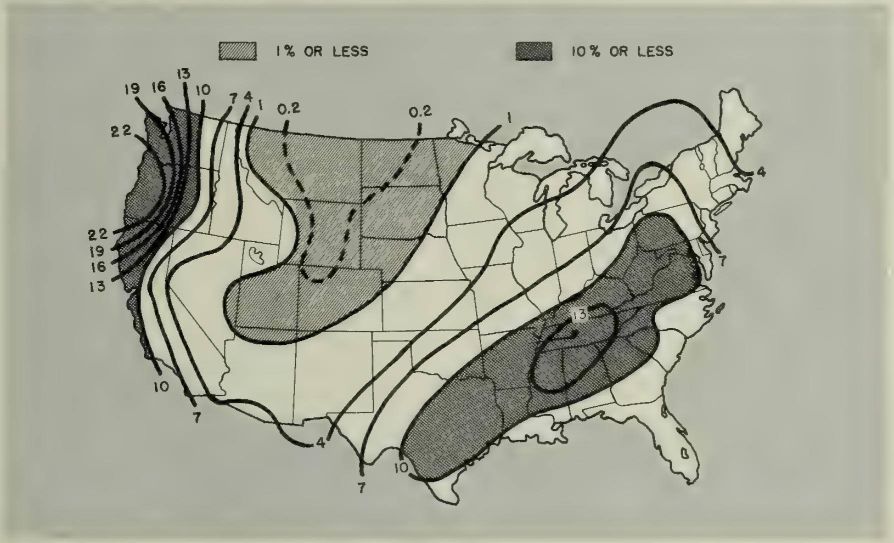
246



Above, percentage of time snow falls in winter. Below, percentage of time fog forms in winter.



Below, percentage of time rain falls in winter.



# . . . . HAZARDS by th

THOUSANDS of tons of hazardous material will be delivered soon to many Air Force bases. It will arrive by air, unpackaged and at unscheduled intervals during the next few months, and every pilot should review the rules for dealing with it.

The soft white flakes which comprise this material can be a grave menace to the accident rate. For within a matter of hours they become dingy gray snowbanks piled along runway edges and overruns, where a hapless pilot may drive into them. Or they melt on the runway surface and turn into slick, rutted ice, a perfect setting for runup and taxi accidents.

Certainly every pilot knows he must keep his eyeballs uncaged when landing at an airfield where there is snow cover. Many an accident investigating board has determined that a collision with a snowbank was caused by lack of judgment, lack of planning or poor technique on the pilot's part. Until a completely new method of snow disposal is found, however, snowbanks will remain a problem and the pilot's only recourse is to remain ever alert to their presence. At night he must be particularly aware of the snowbank danger and should use lights for taxiing. When parking or when turning into position for engine runup prior to takeoff, he must be certain there is sufficient clearance before swinging the tail.

Few commanders will require a pilot to taxi when in the pilot's opinion it is unsafe to do so. Any time he feels it is hazardous to taxi because of slippery surfaces, it is not only the pilot's right but also his responsibility to stop the plane and call for a tug. There is a technique to taxiing on icy surfaces, and it can be learned best through practice. Pilots of multi-engine planes should use power almost exclusively in taxiing on icy surfaces, yet they must not use so much power as to start a turn which cannot be stopped without brakes.

During any preflight, most pilots make a visual inspection of aircraft surfaces and check to insure that controls move freely and properly. These two items are doubly important during the winter. Frost, ice or snow on wings, fuselage, tail surfaces or props should be removed thoroughly, not so much because they increase the aircraft weight but because the rough surfaces induce additional drag and disrupts the airflow. So far as controls are concerned, snow can sift into the smallest openings and either freeze the controls in one position or become packed so that movement may be restricted later. If a pilot must take off from a slushy runway, it's a good idea to move the landing gear through at least one complete cycle after climb has been established. Otherwise slush thrown into the wheel wells may freeze so that the gear cannot be lowered for the next landing.

Although snow removal is the responsibility of the installations and operations officers and not a concern of the average pilot, some of the details of the snow removal program may be of interest to the pilot since the results directly affect him.

During the summer the installations officer sees that snow removal equipment is cleaned up and properly stored, and new equipment ordered. He gets his men lined up for 24-hour duty during the storm season, and sees that they are checked out in the equipment they will have to use. The installations officer supplies both equipment and men for all snow removal operations.

Because the movement of aircraft is affected by the snow removal program, however, the operations officer has over-all control. It is up to him to call for the work to begin. The weather officer advises the operations officer when a snow storm is impending, but the operations officer ordinarily does not ask installations to begin work until the snowfall is about two inches deep. Work is done by pre-arranged priority; that is, the prevailing-wind runway is cleared first, then the access ways.

When crews are working on the airfield proper, the operations officer must schedule aircraft parking and

# TON

Runway edges marked with small trees give a pilot a check point in white-out conditions.

take-off so as to interfere as little as possible with the snow removal work. If you are ready to take off some cold winter day and the tower tells you to wait a few minutes until the snow removal crews finish a pass, don't lose your patience. It's easier to hold an aircraft on the ramp for five minutes than to pull an entire snow removal crew off the runway.

There are two attendant factors to snow removal which are part of the over-all program and which are important to pilots. The first of these is the marking of runways, taxiways and ramp areas. At many bases in the north, edges are marked with spruce boughs or trees, erected at each runway light point and at other points spaced along edges of taxiways and ramps. They offer an added advantage by giving the landing pilot a reference point in white-out conditions, where perspective might otherwise be lost.

Another system for runway marking employs sea marker dye. (See ORANGE AID, page 28.) The dye is mixed (five parts water, five parts sea dye, one part alcohol) and poured in a large drum under pressure so that it can be sprayed on the snow. Runway edges, thresholds, taxiways, ramps, and in some cases runway centerlines, are marked with the colored solution. Without runway markings such as these, lack of contrast between the runway and the surrounding areas may cause the runway to disappear from sight entirely on the final approach even though it was clearly visible from directly overhead.

Whenever ice, fog or snow flurries are present, it's good practice for a pilot to ask for the runway lights to be turned up to full intensity. The lights will aid in judging height above the runway and at the same time will help him to keep oriented in the traffic pattern when other runway markings are not visible.

The second attendant factor in the snow-removal program which should be of interest to flight crews is the use of abrasives and salts for ice control on runways and ramps. Some of the more common of these materials are cinders, sand, washed pea-gravel, coke screenings, sawdust, calcium chloride and sodium chloride. Abrasives are spread carefully so that they will not be sucked up by jet intakes; a multi-wheel, rubber-tired roller, for instance, distributes sand evenly. Some bases are following the practice of commercial airports and using a weed-burner, mounted on a truck and following the sand spreaders, to embed the sand in the ice with heat.

Salts have an injurious effect on aircraft as well as motor vehicles, pavement surfaces and adjacent vegetations, and you will find them used only where all other methods of ice control are unsatisfactory. Should aircraft metal be corroded by calcium chloride or salt, Banox No. 1 will be helpful in nullifying the effect.

Pilots can be of assistance in the snow-removal program by reporting runway conditions when they go into operations after landing. A pilot preparing a flight clearance cannot always depend on NOTAMS being absolutely up-to-the-minute in stormy winter weather. Operations should keep a blackboard in the dispatch section on which ground conditions, as reported by the alert crew and landing pilots, are logged hourly.

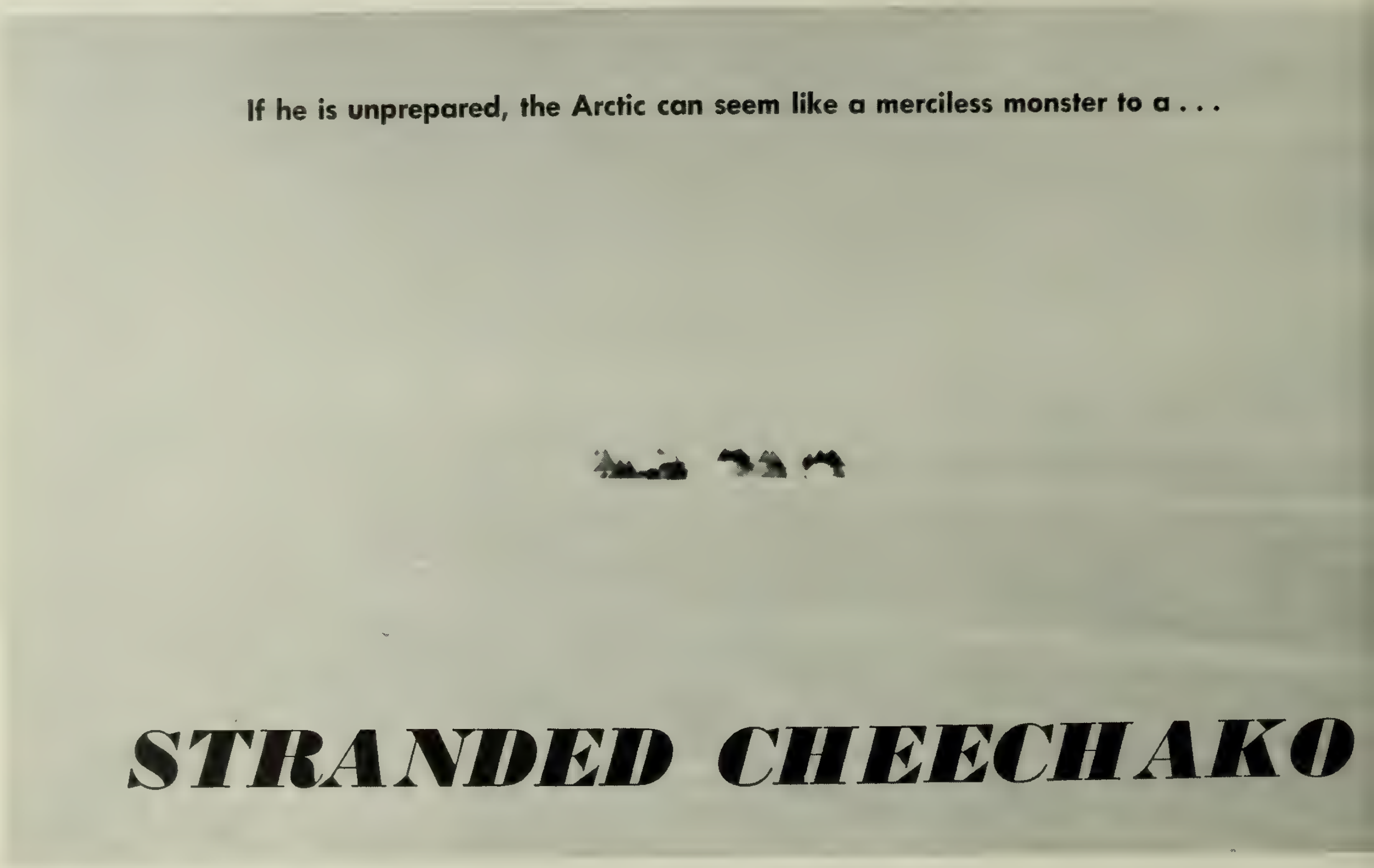
Possibly this reminder about winter weather hazards should end with a few cases in point. For instance, the F-94 pilot who last winter skidded a little on an icy runway, applied too much brake pressure and sailed into a snowbank. The plane bounced into the air, careened tail-first into another snowbank, and was in flames by the time the pilot got out.

Or the F-80 pilot who reached 120 mph on takeoff roll but could not become airborne. When he cut power and applied brakes, the aircraft slid off the runway into a snowbank. Investigators found patches of ice three or four inches in diameter and $\frac{1}{8}$th inch thick binding the leading edge of the wing surfaces.

Or the C-47 which was covered by a thin layer of water when the pilot made his preflight. He discounted the danger of the water, loaded 21 passengers aboard and took off. When about 15 feet in the air, the '47 sank to the left. The pilot applied right aileron and pushed the throttles forward; the left wing came up but the right wing immediately dropped. The plane touched down again about 200 feet beyond the runway with gear still extended, and crashed into a snowbank. The water on the fuselage of course had frozen when the C-47 entered the colder air above the runway.

Remember, dashing through the snow in a one-horse open sleigh may be a real picnic; driving through it in an airplane is something else again. The snow-removal crews will do everything possible to reduce the hazard of ice and snow on the ground. After that, it's up to the pilot to remember the common sense rules. ●

When parking or turning, be certain there is sufficient clearance before swinging the aircraft.



**If he is unprepared, the Arctic can seem like a merciless monster to a . . .**

# STRANDED CHEECHAKO

THE Arctic will seem like a conscious, bone-freezing conspiracy against his life to a Cheechako (newcomer) stranded in the icy hinterlands. That's not true, but the Far North is totally indifferent to man and his yen to live.

The Arctic is a vast chunk of frigid real estate answering only to its thermostat, which is the varying tilt of the earth's axis with relation to the sun. Human life is no factor in this relentless bit of astrophysics. It causes extreme climatic effects that most of us will never face; effects that force a temperate zone man to alter radically his normal habits — or else.

Simply put, the facts freeze down to this: The Far North is neither for nor against you. It's just an impersonal set of rugged conditions you must accept and learn to live with. You'll get less than nowhere battling these conditions with Kid No-Know in your corner as second.

Going down in the Far North isn't a death sentence; far from it.

For untold ages man has lived there without an Uncle Sugar back home to fly him prime beefsteaks, stove oil, ear muffs, and radios. The Arctic today is Home, Sweet Home to tens of thousands of people, many of whom wouldn't leave if you offered them the Empire State Building along with till tapping privileges on the Golden Gate Bridge.

Some of these folk are so primitive they're using Stone Age implements. Yet, making-do with materials at hand, they wrest a livelihood from the icy seas and barren lands. If these people can survive, so can you, providing you know how and are properly equipped.

The U. S. has backlogged a wealth of experience in Arctic living, dating back to the gold rush over Chilkoot and White Horse passes into the Klondike. Wartime air routes over Canada, Alaska, Greenland, Iceland and the north Atlantic expanded this knowledge. Since the war the problem has been scientifically and minutely studied as flying activities stepped up along the eaves of the world's roof.

Should you ever get stranded in the Northlands, the refined essence of this knowledge will be available to you in simplified form. Furthermore, you can be certain that you will be diligently sought by Arctic rescue experts as long as a chance exists that you are alive.

If you are a crewmember making regular flights "down North," you will have had excellent survival training. Should you be a passenger, you'll be glad that such skilled personnel are aboard with you.

However, in case you find yourself separated from the experts, you'll need some knowledge of the dangers that lurk around you. Otherwise you may be like the unfortunate who found himself unarmed in a battle of wits.

Trite, obvious and academic as it sounds, Arctic survival can be summed up in two words: "be prepared". This means preparedness by knowing the conditions you will meet, having the things you will need and knowing how to use them.

The Far North is towering, ice-clad mountains and it is level, treeless plains; it is an ocean hidden under floe ice and wandering iceberg islands boasting weather stations; it's frozen rivers and big spring floods caused by ice jams; it's glaciers that occasionally disgorge ancient animals in good condition; it is temperatures ranging from —80°F. to 100°F.; and it's Greenland, that gigantic chunk of ice doing business as a super iceberg plant.

Necessary survival and rescue methods depend on where you are when you are there. Just how do winter Arctic conditions differ from those we normally meet? 1) It's killing cold; 2) all forms of life (man included) are few and far between; 3) apparently mild sunlight can blind you for a week; 4) you need more food, particularly fats; 5) overland travel is laborious; 6) if you work up a sweat, you're likely to find yourself encased in a sheath of ice later, and 7) during one period the sun never comes up and at another it never goes down, just lazing around and around the horizon.

"Arctic survival" is somewhat of a misnomer, for its methods are often needed in the sub-Arctic, and at times in temperate zones. There are plenty of interior, lowland sub-Arctic places where nature can give you the deep-freeze treatment. Being lost afield in a Dakota blizzard can be worse than camping out at the North Pole.

**A trench, dug in a drift and roofed with snow blocks or tarpaulin, provides a warm shelter.**

There is only a thin fringe of people in the Far North, and virtually all of them cling to the coastline. There's almost nothing to be found back in the inland tundra before you get far enough south to reach the timber line. Further down you begin to find people and larger animals. In the spring, some of the coastal people head south to meet the northern surge of caribou at well known passes. But they have little use for the sparse barrens above the timber line.

Normally the people are found at the head of navigable bays at the mouth of rivers. There are reasons for this, of course. The weather's generally more moderate, and the sea's big larder is at hand. The sea can be used at the peak of summer to bring in heavy supplies.

The frozen rivers can be used as highways for dog sleds and tractor trains in the winter.

Generally speaking, a heavy stillness hangs over much of the Arctic, and violent winds are unusual. Turbulent weather is usually local in nature, and often is a product of the surrounding terrain. The high winds are encountered along coasts backed by tall mountains, and inland due to spotty heating effects and mountains.

Once you get aloft, Arctic flying is very good. A smooth, quiet ride is the rule rather than the exception. You will meet far less turbulence in the Northlands than you will in the interior of the United States. "Iron Mike," the autopilot, really gets in his licks up there.

Perhaps this is more than enough of generalization, so let's get on with the story of you, the Arctic and an air emergency.

As the first item of safety, a flight plan will be filed by the pilot, and traffic controllers will keep an eye on your progress through position reports. If you become overdue, Air Rescue is alerted. A wide-scale search is certain to be launched if you are missing after your fuel-time-limit has elapsed.

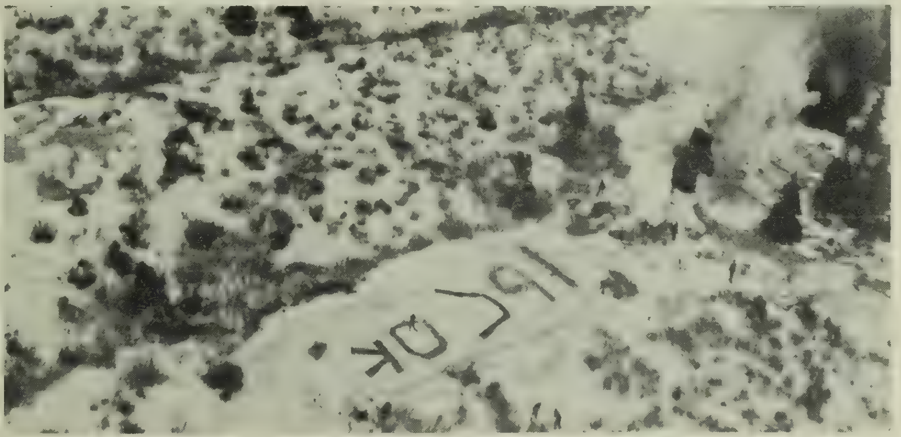
If an aircraft develops trouble, a position report should be radioed immediately. A good position report is the best insurance that you can get for a speedy rescue. It centers the search on you, and prevents wasteful needle-in-the-haystack hunts over great areas.

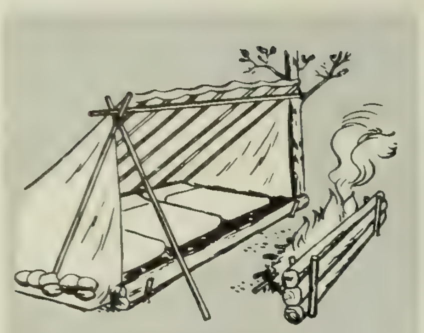
This report should be sent over the aircraft's long range liaison set, and if the situation is grave it should be in the form of an SOS or "Mayday" call. Radio bearings will be obtained on your signals if direction-finding stations can receive you.

Every effort should be made to get a signal out over the strong liaison set while you are still aloft, because your radio might be damaged in a crash landing. In such an event, thereafter you will have only a short-range emergency transmitter available to you — providing it weathers the crash or parachute fall.

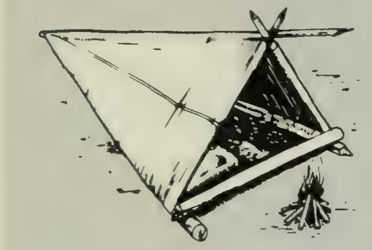
It will do wonders for your morale, too, if you can get an acknowledgment that your distress message has been received. If all of this goes well, you can be located by a pinpoint search with no lost motion. Even if your aircraft and survival kits are lost, a search airplane should be overhead before long to drop you

**This survivors' signal, as seen from the air, tells the rescue aircraft overhead that all passengers and crew of an aircraft downed in Labrador are safe. Signal on the ground reads, "16 are O.K."**

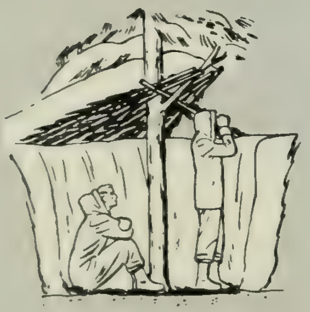




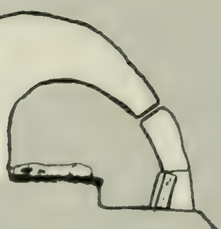
Three man lean-to



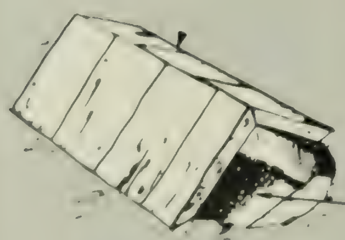
One man shelter



Tree pit shelter



Snow cave shelter



Snow "fighter" trench

food, fuel, medicine and necessary survival gear.

After the distress call, the aircraft commander faces a tough decision. What will it be, belly-in or bail out?

As every Arctic pilot knows, the answer is belly-in if possible. A frozen lake is an ideal spot for such a landing. Your chances of survival and rescue in a remote area are infinitely better if you stick with the aircraft.

Aerial searchers can spot an airplane on the ground far easier than they can a person. Furthermore, you will find your aircraft a treasure trove of equipment that you will need. If you jump, you will have a bare mimimum of clothing and survival material. You may land so far from others in the party that you cannot rejoin them, forcing you to face the Arctic alone.

Of course, there are emergencies that make a jump imperative. Sometimes the terrain and timber will make a crash landing impracticable. It may be so dark that you cannot make a landing, or you may be on fire and in imminent danger of an in-flight explosion.

If an unavoidable jump is made, the parachutists should try to keep track of the aircraft and other 'chutes. If they can mark the spot the aircraft hits, they should attempt to work their way to it as a rallying point for all survivors. Even badly wrecked, there is a lot of material in the airplane that you can use.

Say the aircraft has been successfully crash landed; now let's take a quick run-through on the initial actions to be taken:

- Clear the aircraft immediately with all readily available survival gear. Keep away until the possibility of an explosion has passed.
- Give first aid to injured; treat anyone in shock.
- Construct emergency shelter and build a fire.
- Get the emergency radio on the air on schedule.
- Organize camp. (Determine what's to be done and assign set duties to all personnel.)
- Prepare ground signals.
- If unknown, try to determine your position.
- Keep dry; avoid snow blindness and check for frostbite.
- If in winter, DO NOT attempt to use the aircraft for shelter—even a hole in the snow is much warmer.

Some of these first-firsts can be accomplished simultaneously if you have sufficient people with northern survival training.

Now, to go back over that in more careful detail.

Persons on potentially dangerous flights in the Northlands should wear most of their Arctic clothing and keep the rest of it close at hand. This should be done, even if it means that cabin heating has to be reduced. Thus, in case of a quick bailout, you at least start your ordeal with adequate clothing and a minimum of survival material attached to the back or seat of your parachute.

Survival kits and items should be lashed down in a manner so they can be quickly released near the exits. They should be placed so that the items of highest priority are near the exits.

### Crew Training

The ideal situation is for the entire crew to have received survival training, and then to practice coordinated plans for jumping, crashing and ditching. Each airman should know his duties well and have knowledge of the responsibilities of the others. This is important in case one man is knocked out, then the others can carry on with his assigned chores.

If you belly-in, quickly get injured personnel out and clear of the aircraft. Take out all emergency kits, gear, parachutes, tools and other useful equipment, storing them away from the aircraft in one place. The threat of fire, immediate or delayed, is the reason for this action.

Although the prepared emergency kits are your first targets, don't overlook anything useful, such as pliers, hammers and screwdrivers.

After this first flurry of activity is over, the clothing of all personnel should be checked for adequacy. This is no country for low quarter shoes and baseball caps. Clothing that is wet either from water or perspiration, should be removed and dried. Old Man Arctic detests moisture, and he converts all of it that he can find into ice. Be sure that he doesn't turn your perspiration into an icy union suit. That's why the northern experts harp constantly on the theme of "keep dry." Nature keeps arid in the Arctic through the freezing process. Most people associate ice and snow with moisture, but that's not true up north. Both the snow and ice are bone dry until heat is applied. Newcomers are puzzled by the itchiness of their scalp; it's because of the dryness of the atmosphere.

Here are a few pointers on Arctic clothing that should be helpful:

You create heat internally and it is dissipated at your skin's surface. Clothing merely traps bodily heat and prevents the wind from blowing it away. Insulated air really retains your body warmth. Consequently, two loose-fitting, lightweight garments are warmer than one heavy one. That layer of air does the trick.

You need an outer layer of tightly woven material or animal skin to serve as a windbreaker. Wind is the great thief of your warmth. It sweeps away the still layer of air protecting your body. In the tropics you would be grateful for this as the air evaporates the perspiration in a refrigerating process — but you won't be thankful for it in the Northlands.

So the word is that you need a good windbreaker on the outside and several thin layers on the inside. These layers are handy in avoiding perspiration when you are exerting yourself at hard work or in travel. Just peel off enough layers to keep from sweating. The Air Force and other agencies are constantly striving for perfection in their Arctic clothing and bedding issues. In all probability you will have the latest Arctic footwear, clothing and sleeping bags.

Anyone severely injured should be given immediate first aid. The general rules of medication apply here, but they are complicated by the threat of frostbite, which is a polite term for freezing. The injured should be kept warm, dry and comfortable, and it may be necessary to provide a quick shelter and fire for them. Be sure to get some insulation between them and the ground when you stretch them out.

Shock and delayed shock are common in accidents. In deep shock a person may even forget his name. Sometimes this condition does not appear until hours after the accident.

Special attention is required by those who are bleeding. If tourniquets are used, frequent release of pressure is necessary. Also keep warm that part of the body where circulation is cut off. This last thought does not imply that merely a covering be used. Body heat from some other member of the group should be used in keeping that part of the patient's body warm if no other heat is available.

Once on the ice, frostbite is an ever-present hazard, especially when winds are strong. Frostbite is extremely painful in itself, and if neglected it will develop into gangrene. This is serious and usually requires surgery. It can cause death.

Frostbite usually attacks the extremities — hands, feet, nose, ears and face. Poor blood circulation lets frostbite get a running start. For that reason no clothing or footwear should be binding or tight. Gloves, shoes, belts and drawstrings should all be fitted loosely.

Frostbite is sneaky and can occur rapidly. Its first sensation is numbness. In cold weather, make faces from time to time and touch your face for stiffness. Members of the party should watch one another's faces for grayish spots indicating frostbite. Once these spots are discovered the person should be treated immediately.

A frostbite casualty should be placed in a heated shelter. The frozen part should be thawed in tepid water. The ideal water temperature is 107°F. If warm water is not available, apply heat packs.

### Sun, Snow and Glare

Sunlight and snow can gang up to blind you in one of the Arctic's most painful experiences. Direct solar rays and those refracted from snow are too much for sensitive eyes. It's like burning a photographic negative with excessive light.

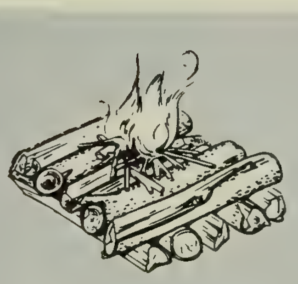
Snow blindness is also sneaky and can occur in foggy, misty weather.

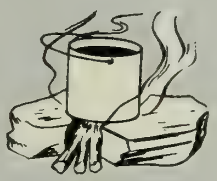
Never be without sun glasses, or their equivalent, during the snow blinding seasons — roughly November through May, inland, and October through May on floe ice. Up toward the pole where the snow is permanent, the danger exists any time the sun is out, and that can be 24 hours a day.

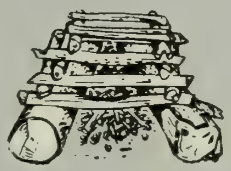
Sun glass substitutes can be whittled from wood, plastic or bones. Cut a horizontal slit 1/16 inch by one inch in the improvised "lenses" so they fit over the pupils of your eyes. The eyepieces should be about ¼ inch thick. Blacken the top and bottom of the slits.

Lacking other material, make a mask of dark cloth, cutting and raveling the slits. It helps to darken the areas of your face around the eyes, using soot or similar material.

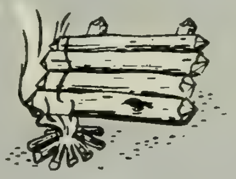
Fuel is a prime necessity, and you are in luck if the aircraft's oil and

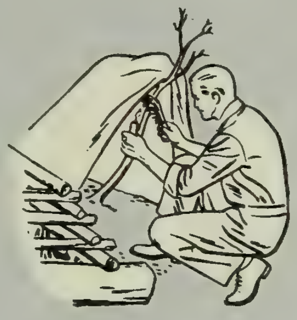

Log platform for fire

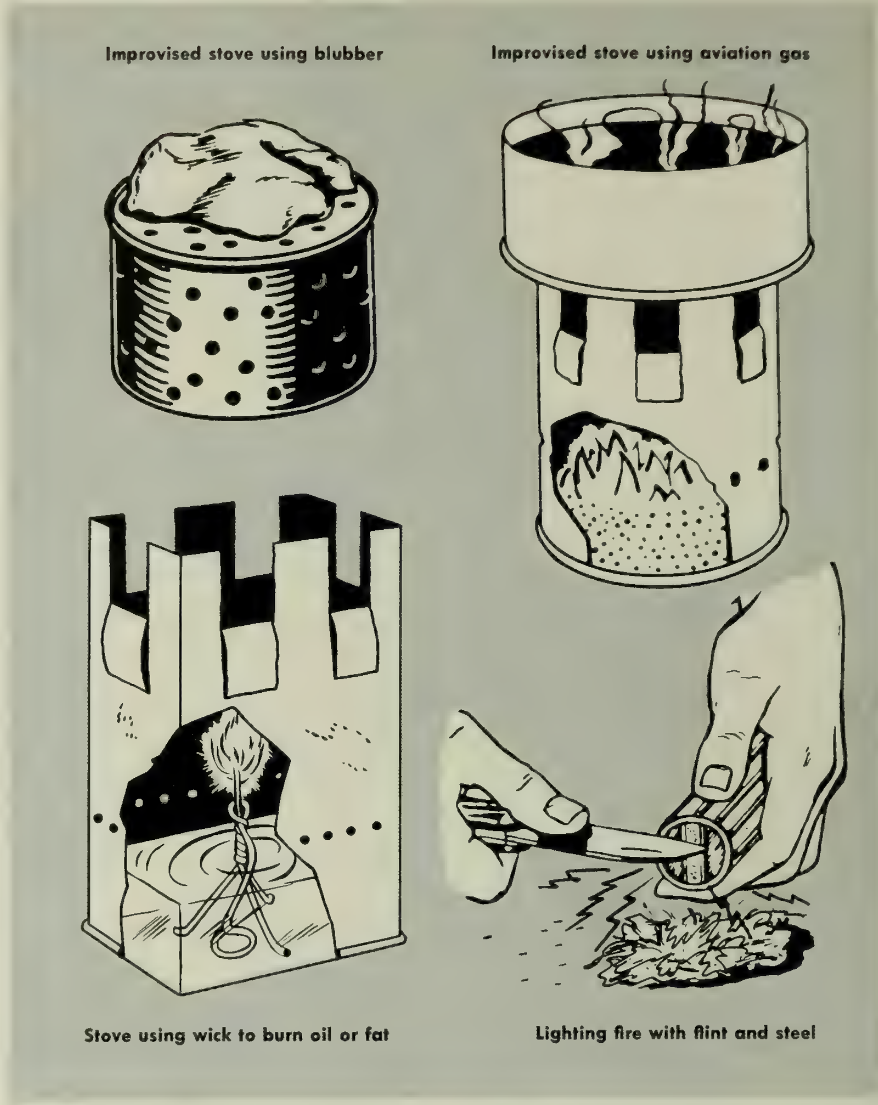

Platform for cooking


Building a pyramid fire

Shavings and dry twigs


Log reflector for fire


Lighting fire with candle



Improvised stove using blubber

Improvised stove using aviation gas

Stove using wick to burn oil or fat

Lighting fire with flint and steel

Fire is life in the Far North. An improvised stove will heat your shelter.

gasoline tanks remain intact. The oil should be removed before the engines cool. It's best to use containers, but they are not necessary. Open the drains and allow the oil to flow out on the snow and ice. It will congeal rapidly and you will have no difficulty in collecting it later as needed. But you'll have beaucoup trouble getting it out of a frozen engine.

Gasoline, on the other hand, need not be drained. What better storage can be found than the aircraft tanks themselves? Accessibility should be considered. If you have tanks that are hard to get at you will want to transfer fuel from them to the main tanks. The ideal is achieved if you can get the auxiliary power unit going to make these transfers.

Watch your hands during this job, being careful not to get gasoline on them. If it's very cold keep your hands off of bare metal. Many a man has grabbed a door knob or wrench and had his bare hand freeze to them.

Now turn your attention to more permanent shelter. (If it's summer, you can stay in the aircraft or make a quick tent by throwing a tarp or parachute over an aircraft wing.) In winter, you will need an insulated outdoor shelter. In selecting a campsite, pick a place for its protection from wind. Get in a timbered spot if possible because the trees will serve as a windbreak and source of fuel. Do not get under snow covered trees, however, for they will soak you when the fire gets going.

Wind-driven snow piles up quickly, and sometimes it avalanches on a steep incline. So it's best not to set up housekeeping at the foot of a sharp slope or cliff.

Where you are and the materials at hand will dictate your choice of shelter, and there are many of them. There are lean-tos, snow caves, tree pits, snow trenches, snow "fighter" trenches, ice houses or igloos and parateepees. In your survival kits will be full instructions on how to build these homes away from home.

Lean-tos are simple to fabricate in timbered country, and they are surprisingly effective. Whatever shelter you select, remember to keep its entrance crosswind. You may find it helpful to erect a wall of snow or ice between your shelter and the chilling wind.

In treeless areas with snow, just burrow into the side of a snowdrift, and "feather your nest" with grass, brush or tarpaulin. Snow caves must be ventilated. If the snow isn't deep enough to support a roof, dig a trench in a drift and roof it with snow blocks, tarpaulin or other materials.

In wooded country make a tree-pit shelter if the snow is deep. Enlarge the natural pit around a tree trunk and roof it with anything available.

Though your instinct may be against it, any shelter will have to be ventilated if you are going to have a fire. Open flame in a tightly enclosed shelter will produce carbon monoxide poisoning.

A sheltered place should be set aside as a toilet. Some crashed parties have used the facilities in the aircraft, or have removed them outside. Adequate shelter, of course, is the chief and immediate consideration.

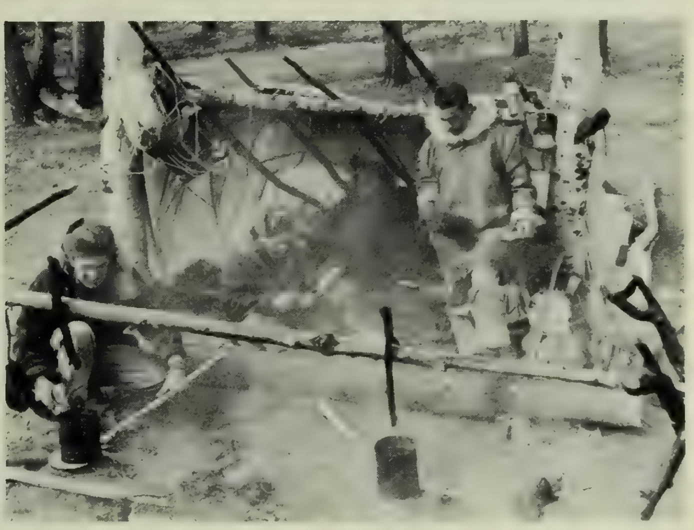
Much of your strength is converted into bodily heat, and you fatigue easily on short rations. Under such circumstances Arctic survivors should get all of the rest that they can, and work should proceed at a leisurely pace. Frenzied efforts at work or travel will leave you gasping frigid air and exhausted. Improvement of your shelter and sleeping bag pays dividends in the rest you will need.

You will not want to sleep directly on snow or ice for obvious reasons. Put boughs or grass down where you are going to sleep. Use your parachute for insulation on top of that, and place your sleeping bag on top of all. Use anything you can for insulation from the cold ground—cushions, tarps or life rafts. An inflated, inverted raft makes a fair bed.

Move the injured to shelter and keep them dry, warm and comfortable.

Use anything you can for insulation from the cold ground and colder snow.

Try to cut fishing hole over deep water where fish tend to congregate.



For three-man shelter, lay boughs from top to bottom, cover with chute.

Of course, a fellow could develop king-sized trouble inflating a raft in an undersized snow cave.

Your sleeping bag is going to be your best friend if you can keep it dry and clean. Some types of bags with feather inner-liners are exceedingly warm — so much so that the inner-liners are seldom used. To keep your bag in good condition, turn it inside out daily and dry it before the fire. Be sure you and your clothing are dry before turning in for the night. If you get frost or ice in your one-man bunk and nightgown, it's hard to get out. Brush and beat it out, because if you melt it before a fire it's difficult to dry completely, and it just freezes again deeper than ever in the fabric.

If you will remember, you have now removed everything that you want from the aircraft to get away from the threat of fire or explosion. With the danger over, place everything back in the aircraft that you do not need immediately. The airplane is an excellent storage place despite its coldness. If there are several feet of snow on the ground, you can lose a lot of tools and materials. They disappear in the snow, leaving no hint of their location. So place your spare stuff back in the aircraft where it will be safe from this thief.

You will not be on the ground very long before you run into the problems of heat and water. There probably will be small stoves of some type in your Arctic gear, but you may have to improvise to make use of available fuel — engine oil, av-gas, wood or miscellaneous flammable material from the airplane. Natives make-do with seal and bear oil.

As for starting fires, there'll be matches in your kit. Furthermore, you personally should carry enough matches to be prosecuted as a potential arsonist. A filled cigarette lighter helps, too. Other methods of fire-making include flint and steel, burning glass, various forms of wood friction, electric sparks and the fusee signal flare.

You can improvise a stove to burn gasoline, lubricating oil or a mixture of both. Put an inch or so of sand in the bottom of a can and add gasoline. Be careful when lighting; the gas may explode at first. Make slots at the top of the can to let flame and smoke out, and punch holes just above the level of the sand to provide a draft. To make fire burn longer, mix oil with gasoline. If you have no can, simply dig a hole in the ground, fill it with sand, pour on gas and light.

### Drinking Water

You will have to melt ice or snow for your water. Ice is much better than snow, yielding more water for the heat expended. If you are in coastal regions or on floe ice, remember that old sea ice produces potable water, whereas fresh sea ice is salty. Do not prepare more water than you need because it will just freeze again. If you inadvertently wind up with more water than you need, encourage everyone to drink as much as they can use.

To conserve fuel all heat must be made to do many jobs at once (cook, melt ice for water and heat and light for shelter) and, whenever possible, substitute fuels should be used.

Communications will be the province of the radio operator, and he can do wonders if the aircraft's radio sets survive, and if he has use of the auxiliary power unit. Otherwise, he will have to depend on the hand-powered CRT-3 known as the Gibson Girl. This transmits on the international distress frequency of 500 kcs. or the aircraft emergency frequency of 8280. These signals can be homed on by search aircraft. Instructions for the CRT-3 will be found with the set. There also is a battery-operated VHF transceiver, the URC-4, for parachutists. It worked well in the Far East, but has not been thoroughly tested in the Arctic. It, too, can be homed on.

The group is fortunate if it has a navigator. He normally will save enough of his instruments to pinpoint the party. If that fix can be radioed to searchers, most of your troubles will be over.

Now, for your ground signals. Normally your emergency gear will include Very pistols, signal mirrors, dye marker, panels, fusee flares and flashlights. The Gibson Girl has a light which can be keyed.

In the Arctic, large SOS signals can be tramped out in the snow, bonfires prepared and dye marker spread over the snow or open bodies of water. Trees piled with brush and saturated with gasoline make excellent flash signals.

Fire and smoke are very unusual in the Arctic, and they rivet the attention of searchers. You need heavy black smoke in daytime, such as that produced by lube oil, and clean open flame at night. Even pin-pricks of light can be seen for great distances at night. If possible, rig up several trees for these fire signals.

Conserve all fuel and food at least until aerial searchers have spotted your location.

If weather or some other factor delays your rescue, begin hunting, fishing and gathering herbs to stretch out your food supply.

Extend your land reconnaissance as time goes on, traveling in pairs for safety.

### Food Sources

Food is scarce in the Arctic, and hunting and fishing figured very little in the reports of wartime survivors. However, this is a food source which cannot be overlooked if you are down for a long time. An experienced hunter or trapper is a big asset to a stranded party.

Your survival pamphlet will contain information on the hunting and fishing possibilities in the area where you are down.

Large animals of the Arctic and sub-Arctic are moose, musk ox, caribou, bears and walrus. Downed parties seldom get a chance at these and are more interested in seals, rabbits, fox, ground squirrels, lemming, mice and birds. In summer there is an abundance of ducks, geese, loons, swans, gulls and grouse, but in the winter you will only find ptarmigans and owls. Natives depend largely on seals for food, heat and clothing.

The Arctic basin has little to offer in the way of edible fish other than cod and sculpin. The inland lakes and rivers usually contain grayling, trout, ling and white fish. The southern coasts in the sub-Arctic have an abundance of sea food.

It is possible to chop a hole through ice for fishing. Try to locate the deepest part of the lake or pond for the hole, as that is where the fish congregate. To keep the hole from re-freezing, cover it with anything available and then heap loose snow over the cover.

Some plant life in the form of roots, berries, barks, mushrooms and lichens are edible. The subject of Arctic food sources is too lengthy to cover fully here, and further information should be obtained in AF Manual 64-5 long before facing the first trip over the Arctic.

Overland travel in the hinterlands is slow, dangerous and tiring at any time. No one should attempt to "walk out" except as a last resort. In the event of a bailout or crash landing, rest a day or two before making any such decision because your judgment may be impaired by shock. Few Arctic survivors have been able to hoof it to civilization, and many have died trying. The tendency of newcomers is to over-estimate their ability.

### Travel is Tough

Tough as it is, travel is easier in winter than during the other seasons. Frozen streams serve as paved roads. In summer the going along the banks of a waterway is difficult; it's a process of stumbling and falling through underbrush, and getting wet crossing tributaries. In winter you can walk over frozen swamps, muskeg, lakes and rivers; you can't do that when water is on the loose.

These warnings against travel however, do not apply in the case of exploring your vicinity. Help may be near at hand in the form of a shelter or a trail leading to people. Get as high as you can on a hill or in a tree for a general survey. In some areas of Alaska and Canada, remote cabins are stored with provisions for stranded persons. There is no charge, but it's a sourdough point of honor to replace anything used.

If ultimately you decide that you must travel, improvise a backpack from your parachute. You'll want a sleeping bag, matches and lighter, compass, a knife, sun glasses, watch, gun and ammunition, wire or shroud lines and food. Wear whatever you have in the way of special northern footwear and clothing. Snowshoes may be worth their weight in gold.

Travel downstream because this will ultimately lead you to larger rivers which wind up on a coast. When not on a waterway, move from landmark to landmark to prevent the usual tendency to circle.

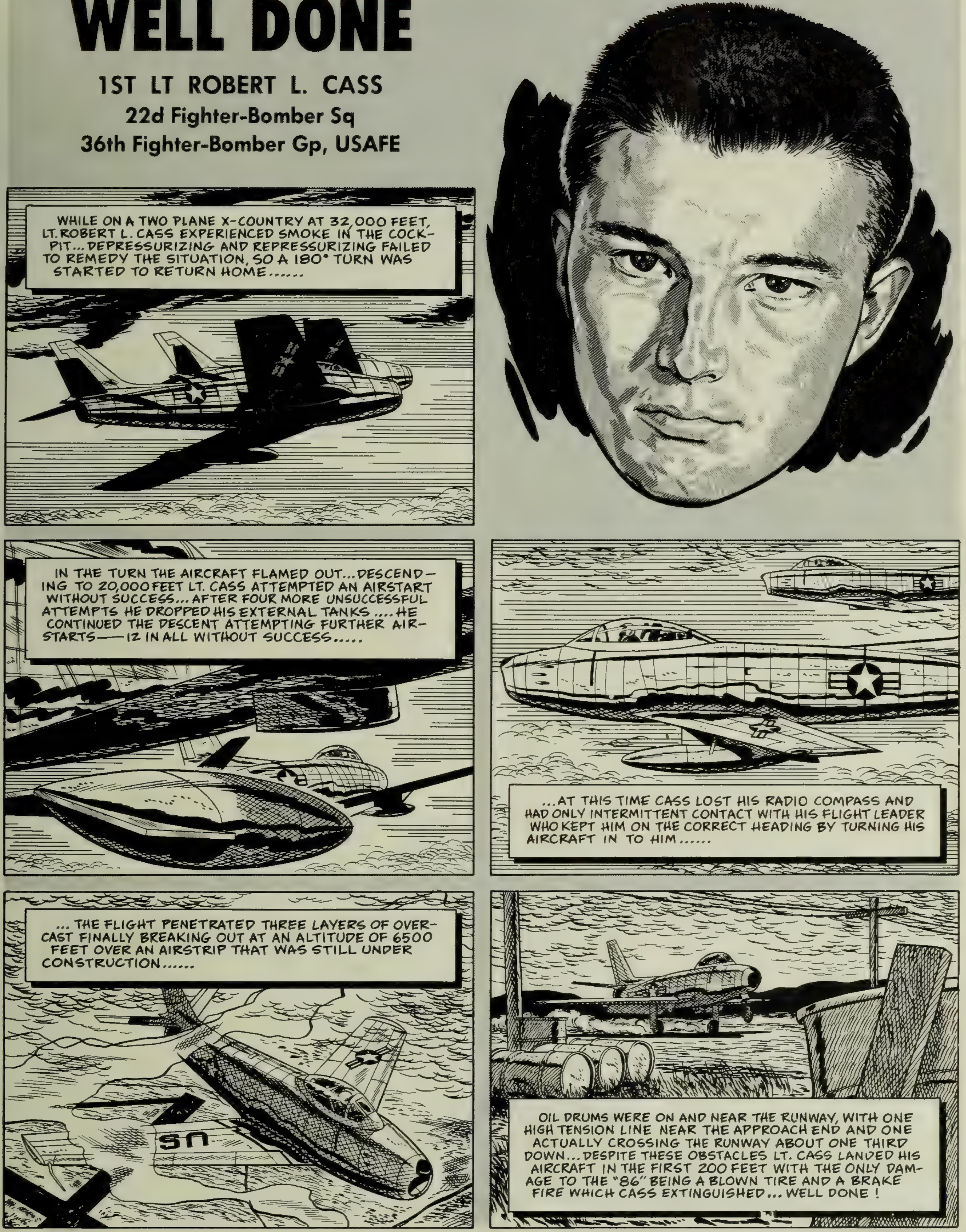
Set an easy pace, for you will be heavily loaded, and make camp early. Halt in mid-afternoon so you can build a fire, cook, make an adequate shelter and get plenty of rest.

You will never go down in the Far North in all probability. But if you do, never give up — remember that Uncle Sam is looking for you and cost is no object. ●

# WELL DONE

### 1ST LT ROBERT L. CASS

22d Fighter-Bomber Sq
36th Fighter-Bomber Gp, USAFE


WHILE ON A TWO PLANE X-COUNTRY AT 32,000 FEET, LT. ROBERT L. CASS EXPERIENCED SMOKE IN THE COCKPIT... DEPRESSURIZING AND REPRESSURIZING FAILED TO REMEDY THE SITUATION, SO A 180° TURN WAS STARTED TO RETURN HOME......
IN THE TURN THE AIRCRAFT FLAMED OUT... DESCENDING TO 20,000 FEET LT. CASS ATTEMPTED AN AIRSTART WITHOUT SUCCESS... AFTER FOUR MORE UNSUCCESSFUL ATTEMPTS HE DROPPED HIS EXTERNAL TANKS .... HE CONTINUED THE DESCENT ATTEMPTING FURTHER AIRSTARTS—12 IN ALL WITHOUT SUCCESS.....
...AT THIS TIME CASS LOST HIS RADIO COMPASS AND HAD ONLY INTERMITTENT CONTACT WITH HIS FLIGHT LEADER WHO KEPT HIM ON THE CORRECT HEADING BY TURNING HIS AIRCRAFT IN TO HIM......
... THE FLIGHT PENETRATED THREE LAYERS OF OVERCAST FINALLY BREAKING OUT AT AN ALTITUDE OF 6500 FEET OVER AN AIRSTRIP THAT WAS STILL UNDER CONSTRUCTION......
US
OIL DRUMS WERE ON AND NEAR THE RUNWAY, WITH ONE HIGH TENSION LINE NEAR THE APPROACH END AND ONE ACTUALLY CROSSING THE RUNWAY ABOUT ONE THIRD DOWN... DESPITE THESE OBSTACLES LT. CASS LANDED HIS AIRCRAFT IN THE FIRST 200 FEET WITH THE ONLY DAMAGE TO THE "86" BEING A BLOWN TIRE AND A BRAKE FIRE WHICH CASS EXTINGUISHED... WELL DONE !

. . . skis resting on ice which is covered by a thin layer of snow can be unstuck by retracting the skis.

# Slick STICKS

WE HAVEN'T touched on ski operation for a couple of years, primarily because there isn't a great deal new on the subject. However, a brief review of techniques appears in order now for some of you may be exposed to this peculiar type of flying this winter.

Just as most of us mastered the rudiments of skiing when we were kids, so too can pilots learn to take off and land on sticks instead of wheels. Years of practice, however, represent the difference between the Olympic champion and the tyro. And it's the same with a competent ski-plane pilot. He has to really *work* to master the art.

There are three prime factors that enter into the operation of any type of aircraft equipped with skis. First, the effect of wind on the plane while maneuvering on the surface. Second, the type of snow that will be encountered, and third, the ability to interpret snow conditions properly while still aloft. The latter really takes a great deal of practice.

There is little difference in the handling characteristics in flight between an aircraft equipped with wheels and one equipped with skis, if the sticks are clean. Should the skis load up with wet snow or slush, however, the added weight and drag will affect the overall handling of the airplane. This is especially true of liaison type aircraft.

Ski-planes have one distinct advantage peculiar to themselves. They can be landed on snow or ice almost anywhere and do not need plowed or rolled runways. But they must be handled gently and with considerable caution while taxiing because of the lack of brakes and lateral control at slow speeds.

To a certain extent, multi-engine aircraft have distinct advantages over single-engine planes when maneuvering on the ground. Turns can be made far easier by proper coordination of throttles and rudder, but the danger of getting into a slide or skid is always present. On the other hand, slow, careful turns demand a wide radius which under some conditions is impractical.

Small craft in the liaison class can be taxied and turned in a very satisfactory manner as long as a severe cross-wind condition does not exist. Often it is advantageous to ease the stick forward while gunning around turns, thereby lightening the tail and placing more weight on the skis. This helps to establish a turning moment. On windy days, however, such practices should be discouraged. It's too easy to get into a skid, hang up one ski and then dig in a wingtip or, even worse, flip over.

Skis without anti-skid type skegs should be confined to soft snow operations whenever possible. They're almost uncontrollable on hard packed snow or ice. Many a light-plane pilot has touched down on glare ice and gone into a merry-go-round act that left him sick and dizzy. Skegs are runner-like projections attached to skis. They'll dig in and act like skates, assisting immeasurably in maintaining directional control.

Wet snow is miserable stuff under any conditions. It's the wise pilot who makes a couple of experimental dry-runs before trying to get off when the snow is piling up over the toe of each ski and freezing. Under such circumstances it's best to make a "runway" for the final takeoff attempt, by taxiing back and forth a few times and establishing some definite tracks.

Takeoff procedures for light planes or multi-engine jobs are approximately the same. Always line up into the wind. Failure to do so, especially in liaison types, may result in a groundloop, induced by weather-cocking. After sufficient speed is built up to allow for good directional control, this no longer presents a problem.

Takeoff run should be made in a tail-low attitude. This must be a compromise between dragging the tailwheel and a level-flight position. Naturally, this will result in slow airspeed when breaking ground and the pilot should then allow the speed to build up as rapidly as possible before attempting to climb.

Soon after takeoff in a light plane, the pilot should visually check the skis to ascertain if the shock cord or hydraulic lifters have pulled the toe up to normal flight attitude. An overload of wet snow will sometimes cause the ski to hang "down at the bow" and greatly reduce airspeed. If this happens, it is best to land and clean the skis. By using original tracks in the snow for the next takeoff, a recurrence may be prevented.

With multi-engine aircraft, directional control on the take-off run is the same as if on wheels. As the plane gains speed, rudder control increases, thereby allowing for increased maneuverability and this in turn permits curved takeoffs, if necessary, because of space limitations or obstructions.

The plane must be held in a tail-low attitude until airborne and then leveled off to gain single-engine airspeed. Only then should the ski control be placed in the UP position. As soon as sufficient speed is built up to cause the skis to "fly" or make the airfoil on the rear of the ski effective, the landing gear should be retracted. If the skis are not "flying" it is possible to damage the oil coolers (C-47) or engine nacelles by retracting the gear too soon.

When taking off in a gooney bird in an area of drifted snow, make the line-up parallel to the drifts which usually follow a definite pattern made by prevailing winds. Such a decision of course is up to the pilot, but attempting a takeoff across drifts can get real hairy.

With power applied, get the tail up just enough to clear the tailwheel and at about 50 mph pop down half flaps. Watch it here though! In a moment you're going to become airborne and the nose of the aircraft must be lowered immediately to pick up speed.

If this precaution is not taken, it is quite possible to lose control of the aircraft in this semi-stalled attitude. As soon as the plane is definitely airborne, place the ski control in the UP position and then carefully milk up the flaps. When they are up, retract the gear and adjust power for desired climb.

One of the primary reasons for pulling off by the boot-straps is to get the aircraft into the air as quickly as possible. Hard-packed snow or ice gives the airframe quite a jolting, and the runs should not be prolonged any more than necessary for a safe takeoff.

## Landing Technique

Before attempting a landing, drop down low enough to give the area a good once-over. While dragging the intended landing strip, look carefully for holes, hummocks, hidden rocks and tree stumps. If you're in doubt about obstructions, make a dry-run a few feet above the snow.

*CAUTION:* On snow-covered lakes or other large areas, it is possible to fly right into the surface because of lack of reference points. This is the same problem faced by the seaplane pilot on glassy water. Here's one solution. Land close to shore, if conditions permit. There you'll have trees, bushes and banks for reference. Of course if you must land in an area far removed from reference points, you'll have to "feel" your way down.

In multi-engine aircraft, power-on approaches should be made with the propellers in high RPM during the last 200 feet of the approach. All ski landings should be made three-point to avoid snubbing the skis and to cut down on the landing slide. Unless the snow or ice condition is known to be hard and smooth, use only quarter flaps. This will preclude the possibility of damaging them. Small pieces of flying ice can penetrate duralumінum like chunks of flak.

In making landings under low visibility conditions and without visual reference in the landing area, start an instrument approach from 500 feet into the forecast surface wind. Maintain a 300-foot-a-minute rate of descent until reaching 300 feet then slow to 150 fpm. Hold this rate until down to 100 feet, then cut descent back to 50 fpm.

The attitude of the plane will be nose-high. A cross check can be made throughout the approach with the radio altimeter. Remember, this is not always too reliable, so use caution. At about 50 feet, visual contact should be made and the landing completed in a three-point attitude. Upon touchdown the throttles should be chopped and the control wheel sucked all the way back and held there during the landing slide.

During all such low-visibility approaches, one pilot should concentrate on the instruments while the other watches out for visual references.

Under some conditions, skis may freeze to the surface while the aircraft is parked. The method of unsticking them will be determined by the surface on which the plane is resting.

If the skis are resting on ice that has a thin layer of snow on it, the skis may be unstuck by retracting them. If the snow is deep and soft, it will be necessary to dig out from under the wheels and place matting beneath them. This may appear somewhat ambiguous. Remember, though, that the skis extend below the wheels when in the DOWN position. A glance at the accompanying illustration should clarify this point.

On light planes, one of the best gimmicks to prevent skis from freezing-in is to place boughs or planks under them before tying down.

Under many conditions, skis will "quick freeze" when the plane is parked for a short while. This condition usually can be alleviated by having maintenance personnel rock the wings while the pilot applies power and bounces the tail up and down by positive application of elevator movement. A bit of caution must be observed to prevent over-controlling. Digging the propeller in could prove embarrassing to explain to an accident investigating board.

One last word of caution: Operations in the open often result in the plane's getting pelted by sudden snow showers. Naturally some of the white stuff is going to cover the wings. Before you attempt a takeoff, *get that snow off!* Coverage only one-quarter of an inch deep can nullify your best attempts. You just won't make it!

In the final analysis, ski flying is practical during the winter months and often the only solution to snow and ice operations. It requires only a bit of preplanning and a modicum of caution. ●

## SEA MARKER DYE

## +

- LIQUID
- PRESSURE
- SPRAYER

## =

# ORANGE AID

COMING in on final, the pilot eased back on the throttle, flicked the trim button lightly and cast a quick glance at the airspeed indicator. The runway appeared to be coming up fast. He applied a touch of back pressure and raised the nose slightly. It was hard to judge distance now. The plowed banks and the white runway blended with each other in a disconcerting manner. The pilot felt as though he were hanging on the white edge of nothing.

The next moment the fighter slammed into the snow covered ground. A grinding impact snapped the pilot against the shoulder harness. Blinding sheets of snow and dirt rose high into the air, momentarily obscuring the plane from view. Twice it bounded with vicious porpoising leaps, scattering pieces of metal like shrapnel. Then it stopped. The clouds of snow settled slowly, quietly.

The pilot was unhurt but the plane was a total wreck. The accident was caused by undershooting. Initial touchdown was 400 feet short of the runway, where drifted snow had formed small but formidable barriers.

Accidents of this nature can, in most instances, be prevented. There are several methods, currently in use, for marking snow banks, runway edges and obstructions. Some bases use evergreen boughs as markers. Others employ colored flags. Often, flare pots are utilized at night. All of these work, up to a point. The suggestions that follow can well be used in conjunction with any of the above.

The problem area, from the pilot's standpoint, exists from the last turn onto final approach to actual touchdown. Many types of markers that are visible directly overhead fail to do the job when approached from an oblique angle. Sometimes it is impossible to judge height above the ground because snow itself will not serve as a reference. A white runway, white banks and white terrain all blend in together.

Recently we received an excellent suggestion for marking snow covered runways and taxiways. This was submitted by Major Wayne L. Daniel, who is stationed at Elmendorf AFB and who reports that the system is paying dividends in that part of the globe. Here is his explanation of methods and equipment.

"Clean the snow from the runways and taxiways as usual, especially exposing the permanent side markings or lights. Then apply a non-hazard longitudinal center stripe down the runways and taxiway, using a suitable coloring material such as a water soluble dye. Such a dye is the standard Sea Marker. When Sea Marker is dissolved in water in a concentration of one-quarter to one-half pound per gallon and sprayed on snow, it will color the surface of the snow a light to a dark orange color, depending on the volume of solution used per unit area of surface. Such a surface gives an excellent contrast against the white surface of the snow. The contrast diminishes in effectiveness as the background color darkens. Thawing will cause this dye solution to spread, but thawing conditions will seldom prevail once winter sets in. In freezing weather, the equipment used to spray this water solution of the dye would have to be prevented from freezing either by applying heat or replacing 30 volume per cent of the water solution with methyl, denatured ethyl, or isopropyl alcohol, which would prevent the solution from freezing down to 0°F.

The only markings needed are the runway and taxiway center lines, one foot in width. An ordinary garden hose of suitable length, and nozzle will give the correct spray, provided the pressure on the liquid is maintained at 20-30 pounds/inch.

"The color contrast is dependent on the volume of dye solution applied per unit surface area and this can easily be controlled by the speed of surface coverage. The degree of color contrast is dependent on variable conditions and should be worked out by actual trial.

"One gallon of the dye solution should cover one hundred to three hundred square feet of surface area. To mark an average Air Force base, approximately 100 gallons of the dye solution would be required, using approximately 25 pounds of dye.

"This dye is standard Sea Marker, AF Stock, Class #27-A, Stock #7300-379000, nomenclature, Dye-Fluorescence in Soluble, packaged in 9½-ounce cans.

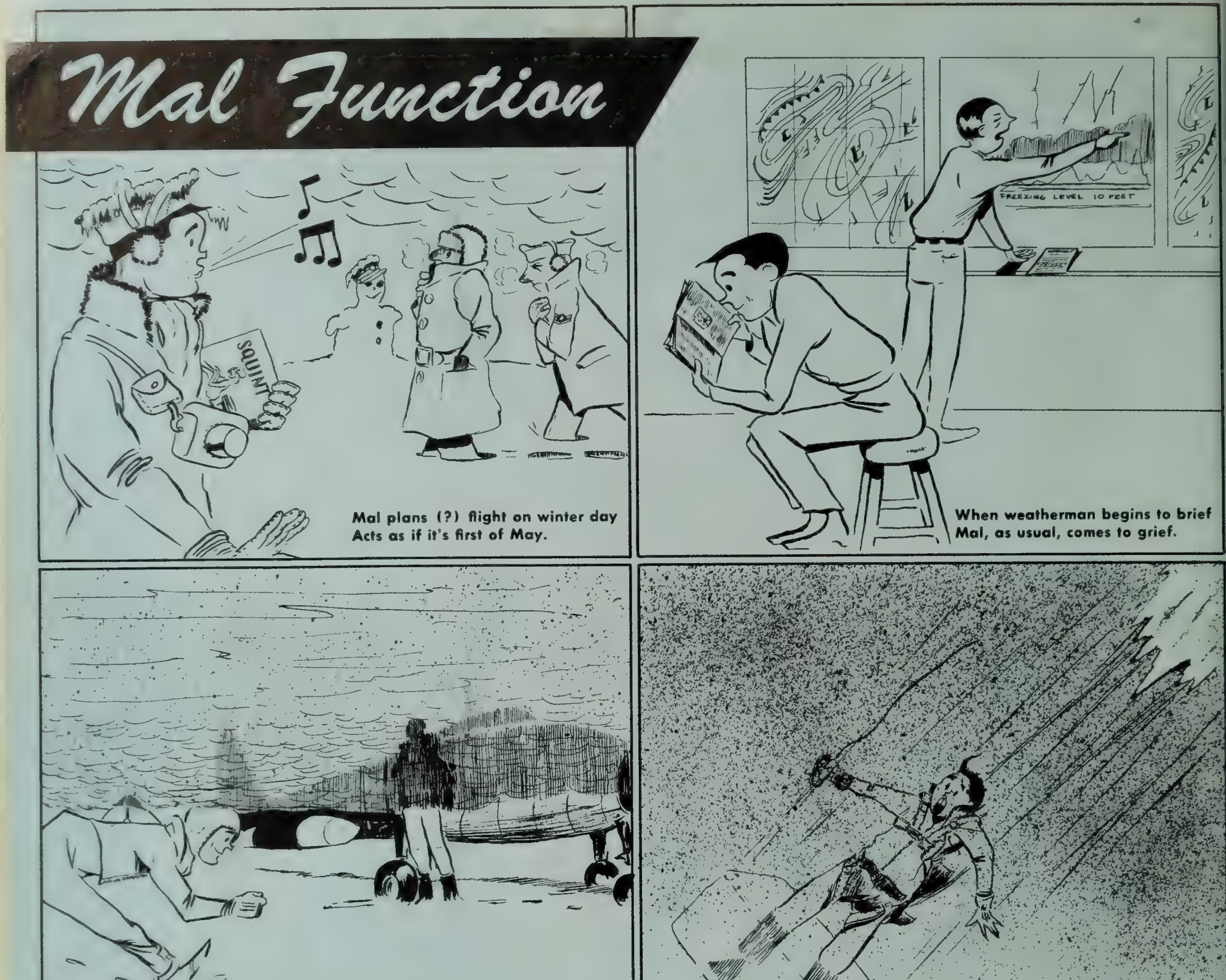
"To elaborate a little, here is how we ran the first test: An old water tank was found in salvage. We welded a regular water faucet on the low end of the tank and welded a regular innertube air valve on the top. About five or six feet of garden hose with regular nozzle was attached to the faucet. This tank was put on a trailer and hitched to a cletrac, the necessary air pressure being obtained from the compressor on the cletrac. That's all there was to it. We then pulled this contraption down the center of the runway, varying the speed and nozzle adjustment until we obtained the desired effect." ●

# *when in Rome . . . .*

Do as the Romans do or, in this case, as the sourdoughs do. The lovely in this picture has the right idea. She finds herself in the Far North and is dressing in the proper clothing for the arduous winter weather, although she looks as if she could use some help. Volunteers form right, please.

Flight coveralls and low-cut oxfords just won't do up in Santa Claus land. We heard of one crew that ditched right off the end of a runway and literally almost froze to death before help arrived.

# Mal Function



Mal plans (?) flight on winter day
Acts as if it's first of May.

When weatherman begins to brief
Mal, as usual, comes to grief.

For moist, cold air, he has no feeling
Pays no heed to low, low ceiling.

Aloft, he soon gets ice, knee deep
With ceiling zero, Mal must leap.

Once more our hero has tempted fate
To save his skin, he'll hibernate.

★ U. S. GOVERNMENT PRINTING OFFICE . . . 27114

FLYS

NOVEMBER 1954

# FLYING SAFETY

UNITED STATES AIR FORCE

[illegible]
DEC 14 1954
UNIVERSITY OF ILLINOIS

The ADIZ Story . . . . Page 2

# FLYING SAFETY

VOLUME TEN NUMBER ELEVEN

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**This month our cover symbolizes the close coordination that exists between the detection and the interception phases of the ADC network.**

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★ ★ ★

The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payment can be made for manuscripts submitted for publication in FLYING SAFETY magazine. Contributions are welcome as are comments and criticisms. Address all correspondence to the Editor, FLYING SAFETY magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Non-Air Force organizations must query the Editor before reprinting, indicating how the material will be used. The contents of this magazine are informational and should not be construed as regulations, Technical Orders or directives unless so stated.

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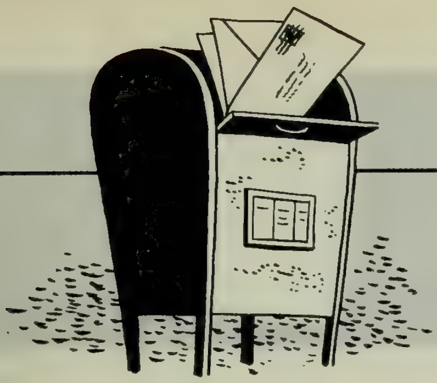


# CROSS FEED

## LETTERS TO THE EDITOR

### Another Safety Record

Twelve consecutive months of flying both combat and training missions without a single accident was the flying safety record set recently by members of the famed Para-Dice Squadron, 3rd Bomb Wing, Korea.

Lt. Col. Lawson Clary, Commander of the B-26 night intruder unit which completed more than 13,000 hours of flying during their safety-record year, lays claim to no secret formula and says, "We've been as careful as possible to see that our people are thoroughly checked out and know their jobs and equipment."

High quality and "best" are traditions with the famous squadron, which, in 1927, was commanded by a young Lieutenant named Hoyt S. Vandenberg.

**Office of Information Service**
**Hqs FEAF, APO 970**

★ ★ ★

### Down Boy!

I would like to point out an obvious discrepancy in your magazine that could easily lead to other people doing the same thing. I am referring to the picture accompanying the article "Best Test" on page 28 of the July 1954 issue of FLYING SAFETY. This picture illustrates a gentleman (assumed) blowing back into his regulator. That's fine, and as we teach, *but,* the picture also shows something else that is verboten and that is the caps covering the inhalation valves in his mask have the arrow pointing "up." I don't know how that could have happened for the caps are distinctly marked with the arrow pointing at the word "down," which I believe means "down." I hope no one has, in the meantime, seeing the picture turned theirs up, for the covers are to prevent moisture and gunk from collecting and probably freezing. The moisture won't drain with the arrows pointing "up," which foils their purpose. They also protect the sensitive inhalation valves from dust, a necessity at this station and many others.

**M/Sgt Perry W. McGlynn**
**Aviation Physiological Training**
**Webb Air Force Base, Texas**

*The Sergeant's absolutely right. This serves to emphasize the importance of thorough oxygen preflight checks before every flight.*

★ ★ ★

### Useful PEST

Congratulations on your article "May I Ride With You?" which appeared in the July issue of *Flying Safety Magazine.* The lack of complete meeting of the minds between aircrew and passengers on many flights has undoubtedly produced unsafe conditions for persons concerned. The passenger's viewpoint as portrayed in this article should certainly be an eye opener for many of us pilots.

The extra trouble and responsibility involved in properly preparing "hitchhikers" for a safe flight might cause many of us to classify them as pests were it not for the fact that this extra preparation provides for a safer and more pleasurable flight for all aboard. Unquestionably, there is not a pilot in existence who would enjoy feeling responsible for an unnecessary passenger death caused by improper preflight briefing.

The word PEST itself, incidentally, provides a convenient mnemonic check list for both pilots and passengers alike to insure that a reasonable briefing has been given in regard to emergency procedures. For example:

P — PERSONAL EQUIPMENT (Insure correct fit and knowledge of use of parachute, mae west, etc.)

E—ESCAPE (Adequate briefing of routes and methods of escape from the aircraft in event of bailout, ditching or crash landing.)

S — SIGNALS (Explanation of signals to be used and correct action to take when signals are sounded, i.e., alarm bell, interphone, etc.)

T — TERRAIN (Briefing of terrain over which the flight will be made, and the proper parachute landing, rendezvous system and survival procedures for same.)

Maybe "hitchhiker" flights would be a bit safer for all concerned if pilots would give a thought to PEST, and passengers would PESTer their pilot for adequate briefings.

**Captain John K. Higdon**
**Headquarters, 27th Air Division**
**Norton Air Force Base**
**California**

★ ★ ★

### ACIC Charts

We, of Westinghouse Electric Corp. Air Arm Division, have a keen interest in the article "Facility Charts—Jet Size" by Col. R. W. Philbrick (FLYING SAFETY, June, 1954). We would greatly appreciate information from your office as to how to obtain these charts.

Additionally the jet letdown charts entitled "U. S. Air Force—U. S. Navy Pilot's Handbook, Jet—Eastern United States," with revision mailings would appreciably aid our program as well as add immeasurably to our flying safety program.

Your magazine is avidly read by all of our pilot staff and is contributing to our flying safety by its many interesting and informative articles.

Thank you for the courtesy extended in our behalf in procuring the above mentioned charts.

**J. W. Tyler, Chief Pilot**
**Westinghouse Electric Corp**
**Air Arm Division**

*When bogeys are up, ADC will find out*

# Who?

THE WAIL of the warbler alarm smashed into every corner of the alert hangar and into the calm of the ready room. Talking ceased, magazines tumbled to the floors, cigarettes were left to burn themselves out in their ashtrays — Scramble Red One and Red Two!

Two F-86D pilots raced down the steps and ran to their waiting aircraft. Ground crews had started the APUs and were standing by to strap the pilots into their seats. The alert hangar doors had opened and the deafening thunder of the jets mounted until, less than three minutes from the initial alarm, two "Dogs" roared into the black of night to hunt out an unidentified intruder.

The flight leader switched his UHF to the proper channel for his waiting GCI controller and wondered, "Is this just another of our aircraft off course as it penetrates the ADIZ? Or maybe it's a friendly airliner coming into the coastal ADIZ from Hawaii ahead of schedule. Well, we'll soon find out." He knew all too well that it could also be a hostile aircraft.

The odds are against this unidentified plane's being hostile. Good odds, but no bets are taken on this situation until the F-86s determine if it's a sure thing or not. Interception of friendly aircraft has become routine with many ADC pilots, but these pilots also are aware of the importance of the air defense mission.

To carry out this mission the Air Defense Command has organized three Air Defense Forces in the continental United States: Eastern Air Defense Force, Continental Air Defense Force and Western Air Defense Force. Each operates independently of the others, the idea being that should any one be partially knocked out, the others would not be affected and could continue operation.

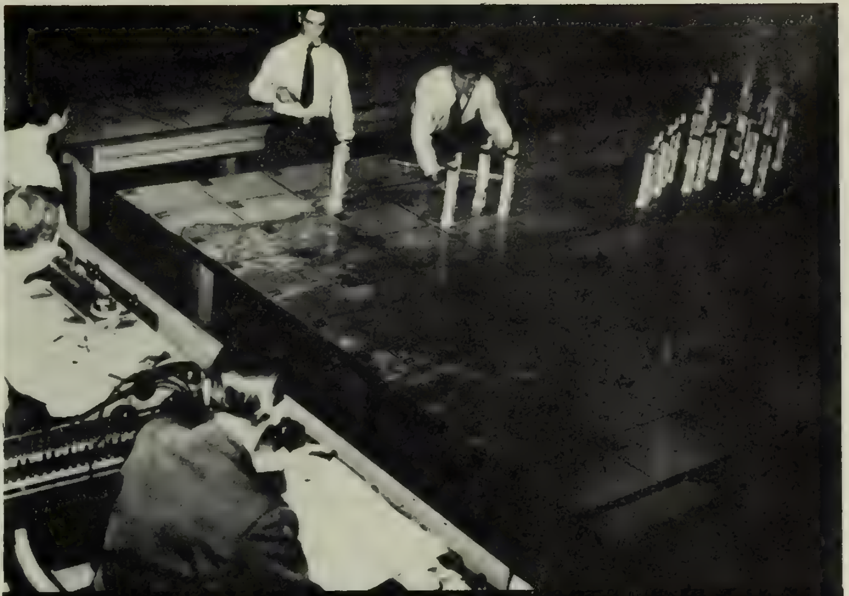
Each of these forces is divided into Air Divisions, Wings, Groups and Squadrons. Each division has its own organization of radar stations, interceptor bases, control centers, filter centers and ground observer posts, all working together to build a formidable wall around our nation's boundaries.

Assigned in a supporting mission, but in the role of a major teammate of the Air Defense Command, are the anti-aircraft artillery units of the Army which are equipped with anti-aircraft guns and ground-to-air guided missiles.

The Alaskan ADIZ, which extends from Point Barrow to the southernmost tip of the Aleutian Islands, and the Hawaiian Islands ADIZ, which covers almost 200,000 square miles of the Pacific also have a paramount responsibility in the defense of our outlying territories.

Since ADC cannot know what is in the mind of an intruder or upon what basis he might decide to launch an air attack, ADC must be prepared to go into action seconds after it receives a warning of the approach of unidentified aircraft. Its operations are divided into four distinct phases: detection, identification, interception and destruction. The success of each phase is dependent directly upon the success of the preceding phase. A description of these functions gives a concise and comprehensive picture of the goal and workings of the system:

- Detection — The Air Defense Command relies on an extensive network of radar stations and the volunteer services of the Ground Observer Corps to detect unknown aircraft.
- Identification — A system of zones of controlled flight areas has been devised along the boundaries of the United States and around certain vital areas of the interior. These are called Air Defense Identification Zones (ADIZ). All aircraft flying through an ADIZ are required by law to file a flight schedule in advance of their penetration. (The only exception to this law would be small, civilian aircraft who stay below 4000 feet above the ground and do not penetrate the ADIZ from a foreign country or an oceanic area.) Use of these flight schedules by those engaged in identifying aircraft detected by radar or by ground observers, reduces the problem considerably.
- Interception — When the aircraft under observation cannot be identi-



- Left, after the alert hangar doors opened, the deafening thunder of jet engines mounted as two interceptors roared away to hunt out an unidentified intruder.
- Above, every aircraft is tracked on a plotting board in a Combat Operations Center as controllers stand by ready to scramble fighters at a moment's notice.
- Below, a GOC post, an important member in the ADC team. Manned by volunteers, thousands of these observation posts help fill gaps which radar cannot plug.

fied readily by correlating its proposed flight plan with the radar pick-up, interceptors are scrambled, and a visual inspection is made to ascertain its identity.

- Destruction — If the aircraft is identified as hostile, it must be destroyed. Today this destruction would be accomplished through the use of air-to-air rockets which are automatically fired by the electronic brains of the interceptor.

Although training for all four phases goes on daily, there are many instances each month where actual scrambles are called to intercept unidentified aircraft penetrating an ADIZ. Air Defense Command will never be able to gamble on the identity of any of these intruders, for there is too much at stake to take any unidentified aircraft situation for granted. So far, all of the "unknowns" have been friendly aircraft which have not followed the outlined procedures for ADIZ identification.

Facts compiled concerning the violations of the various ADIZs show that almost all violations have resulted from ignorance of the proper reporting procedures governing flights into and within the zones. Although this information is readily available to pilots through the Radio Facility Chart or the Supplementary Flight Information Manual, many still fail to follow the prescribed procedures.

It is not only the wasted effort and expense resulting from violating the ADIZ that should concern all pilots, but also the subsequent repercussions. For military pilots a violation of this nature could result in a court-martial punishable by dismissal from the service, two years imprisonment and forfeiture of all pay and allowances. Civilian pilots are liable to a fine of $10,000 and one year in prison.

Obviously, spending a little time to understand the proper procedures is well worth the effort. The mechanics of filing flight plans and reporting positions when planning a flight involving an ADIZ are basic and easy to remember.

### Filing a Flight Plan

DVFR flights have to be filed prior to takeoff whenever a VFR flight will enter or operate within an ADIZ. The flight plan will include the route to be followed and the altitude to be flown while within the zone. The same is true of a flight which will penetrate a Canadian ADIZ (CADIZ) if the flight is to be conducted at an altitude above 4000 feet.

The flight plan can be filed either in writing or by telephone with the appropriate aeronautical facility, and once filed, it should not be changed or altered in any way except in an emergency. If it does become necessary to revise your flight plan, transmit the change immediately in an effort to avoid possible interception.

### Position Reports

Position reports will be given prior to entering an ADIZ. The report will include time, position and altitude at last reporting point along flight path *prior* to penetration and the estimated time over the next reporting point. If compliance with this is impractical, time, position and altitude of penetration should be given at least 15 minutes prior to entering. While within the ADIZ, position reports will be given at least once each hour. When leaving an identification zone you are not required to render a position report unless, of course, you are entering another ADIZ.

These procedures apply to DVFR flights or IFR flights off airways, involving the ADIZ. For IFR flights within Air Traffic Control areas you are only required to use the standard IFR procedures.

### ADIZ Tolerances

If you find that you will have a deviation of more than five minutes from your expected time of penetration, or will be 10 miles off course of expected point of penetration or 20 miles off course of penetration of a coastal ADIZ, immediately transmit this information to the nearest point. A deviation of any more than these limits constitutes a violation, and a scramble will be ordered to intercept your aircraft.

There are times when an interception may be ordered through no fault of the pilot of the intercepted aircraft. This could happen if an in-flight emergency was encountered which necessitated changing the proposed flight plan, or if the communication channels did not forward the flight plan to the proper agencies in time for them to anticipate penetration.

In the event you are ever intercepted, never try any evasive action. Maneuvers of this type will be considered hostile acts, and the pilot of the interceptor would be within his rights to carry out the final phase of the ADC system — destruction.

Remember, the interceptor pilot's mission is to identify the violating aircraft and he can do this only if he is allowed to come alongside and visually note your aircraft numbers. In the event you are intercepted at night, never shine signal lights, flashlights or spotlights at his aircraft. He knows where you are, and the lights will only blind him. A blinded pilot could miscalculate, and a mid-air collision might be the result.

Following an interception, the interceptor pilot may be unable to obtain a clearance for your aircraft. In this case, he will signal for you to follow him by rocking his wings. This means that you are still classified as "unknown." Any prolonged, unescorted continuance of your flight through the ADIZ as an "unknown" could lead to an unhappy and early ending for your flight.

Every pilot in the Air Force today should know how to file a flight plan and how to make proper position reports. The only additional information he must know before flying through an ADIZ is when and where to apply this information. It sounds easy, it is easy. Yet scrambles are still daily occurrences throughout the Air Defense Command.

But let's return to our two F-86s who have just returned to the alert hangar to fill out their reports. What did they find on their mission? You guessed it. A USAF aircraft penetrating an ADIZ without proper clearance.

The boys had another rather rough night of weather flying, an elusive target and a GCA landing through a low layer of fog, but they aren't through for the night yet. Information about the violation has to be recorded immediately so that reports can be sent through channels to the various commands to insure that action will be taken to prevent recurrence. The pilot of this aircraft is about to learn the importance of proper procedures, the hard way. There may not be another time for him. ●

International cooperation is the by-word as a Canadian WAF and a USAF airman track aircraft inside the ADIZ on a plotting board in a Combat Operations Center.

# Hidden Help

LAST December FLYING SAFETY printed the results of the original meeting at McChord Air Force Base, held for the purpose of establishing definite procedures for utilizing the air defense radar nets as an assist for lost or distressed aircraft. At that time a definite procedure had been developed for use in the Northwest area only, now emergency procedures for radar assistance for aircraft in distress are in effect in the entire Air Defense system.

The Air Defense Command's radar network is operational on a round-the-clock basis with coverage throughout the Air Defense Identification Zones and extended adjacent areas. Its radar and communication facilities have the inherent capability of assisting aircraft which are lost or in distress, and procedures are being adopted utilizing this capability.

Aircraft in distress can be directed to an area of VFR conditions, controlled through a safe instrument letdown or, in the event of no radio contact, aircraft can be intercepted and led to a landing area.

The radar control system has adequate communication facilities and can work distressed aircraft with operational radio transmitter and receiver through CAA installations or direct on VHF (121.5 mc) or UHF (243.0 mc) emergency channels. Procedures also have been established for use in the event the distressed aircraft experiences radio failure (transmitter or receiver or both) and are outlined in the back of the facility chart.

In the event of an emergency, radar assistance can be improved upon if pilots would follow some of the accepted procedures. Remember, radar is restricted to line-of-sight coverage, so it follows that altitude is a very essential commodity.

Climbing to the emergency altitude or at least out of the soup, on top, is a good way to keep clear of possible high terrain and other aircraft as well as enhancing the chances of a radar pickup. You also will be expected to have your landing lights on along with your IFF equipment, if installed. When radio contact is established, the pilot should give his estimated position, type of aircraft, altitude, speed, endurance remaining, state of emergency and assistance desired. Remain on the radio frequency on which contact was made until advised otherwise and comply precisely with the instructions received.

If the distressed aircraft without radio contact is intercepted, an attempt should be made to contact the interceptor pilot on the emergency frequency. Even though your radio seemed inoperative before, contact may now be possible because of the proximity of aircraft. If contact is made, describe your emergency and indicate what assistance is desired. If no radio contact is made, get in trail formation and follow the interceptor. It is well to remember that if the interceptor is a jet type aircraft, a minimum of 160 knots IAS is required. Upon making visual contact, the interceptor will turn on landing and navigation lights, inform the controller of the intercept and lead the aircraft in accordance with the radar controller's instructions. The advantage of being VFR for the intercept is obvious, for actual IFR conditions may prevent the distressed aircraft and the interceptor's joining in formation. During IFR conditions the final decision as to whether a closure to a visual contact can and should be made rests with the interceptor pilot.

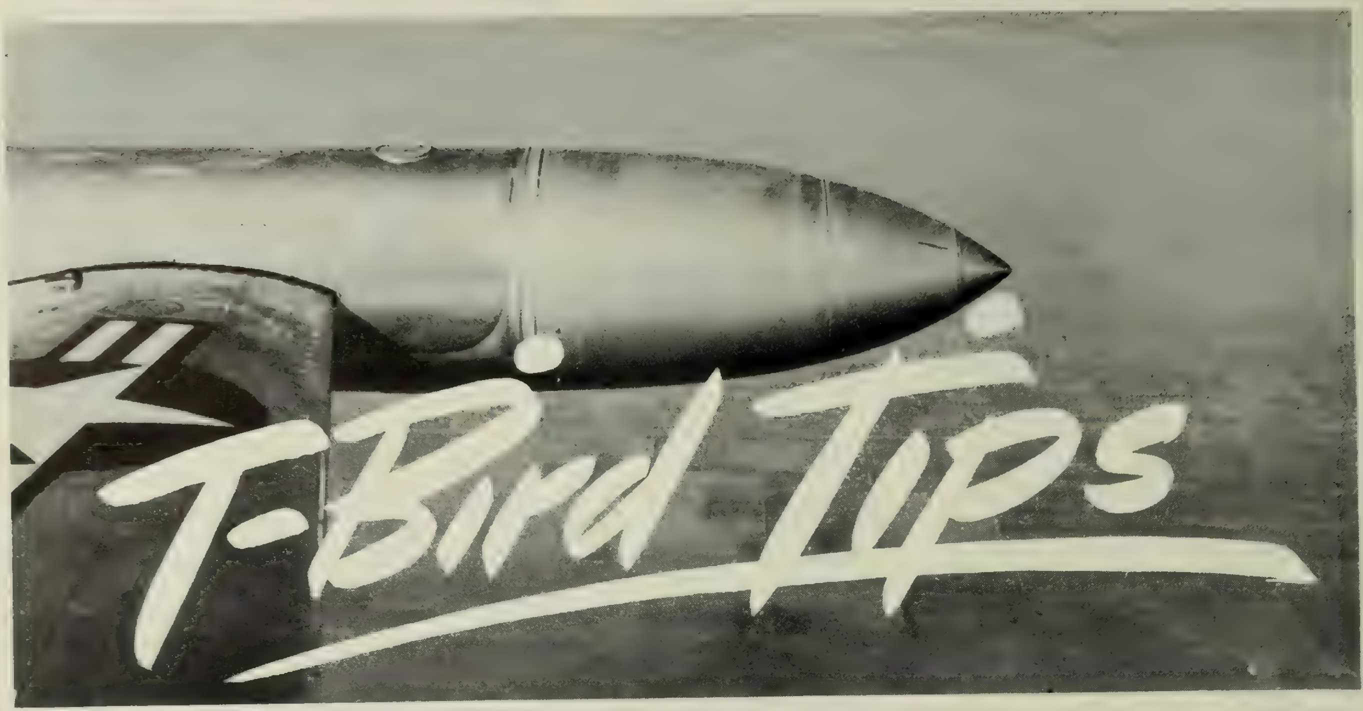
It may be necessary for the interceptor to break formation prior to leading the aircraft out of the emergency. Under these circumstances the interceptor pilot will do one of the following:

- Request the distressed aircraft to continue the initial course indicated by switching its lights from steady to blinking and again to steady prior to breakaway. This signal may be used to head the aircraft toward an area of VFR conditions where a landing can be made without further assistance.
- Request the distressed aircraft to resume the distress orbit by switching lights from steady to blinking, maintaining formation for 30 seconds prior to breaking away with lights still blinking. This procedure will be used, for example, to hold the aircraft while another interceptor is being vectored to it.

Except to divert the distressed aircraft from high terrain or to request identifying turns, the radar controller will not direct the aircraft in a manner different from the directions of the ARTC agency responsible for the aircraft. The radar station will maintain direct communications and will coordinate with that agency throughout the entire operation.

Use of the described procedures for testing purposes may be authorized by receiving approval directly from Radar Control on 133.20 mc or 364.2 mc, or from the Air Defense system through either Military Flight Service or CAA facilities.

The Air Defense Command certainly is not attempting to take over the control of, or responsibility for, aircraft in emergency. If required, the radar network is at your service; however, its primary function is not assisting distressed aircraft. Assistance and actual intercepts in particular are last chance attempts to avoid a possible disaster. ●



# T-Bird Tips

By Maj. James A. Jimenez, Review and Analysis Group, D/FSR

A SAGE once remarked, "Experience is the best teacher." The expression still holds true, but it's very likely that the word *experience* has taken on a new look. In the field of military flying we not only think of experience in terms of flying hours but also in training hours. Flying experience becomes an intricate hodgepodge of link trainers, simulators, system mock-ups, dash one handbooks and T.O.s, lectures, briefings, bull sessions, magazine articles and, ah yes, flying. Give a man the right dosage of each of the aforementioned, with a few other little details, and he winds up as an important and vital cog in a highly technical and mechanized outfit — the U. S. Air Force.

In this article I'm going to go over some of the "little details" which are not always covered in T.O. publications or local SOPs. Some of these details or tips come from experience the hard way, and others from a few of the "old hands around the ranch." It is hoped that these tips will help some of you T-Bird pilots learn the easy way and keep you from having accidents.

Let's review a couple of malfunctions which often have been the cause of accidents or of some pretty hairy incidents in the T-33A. Some of you undoubtedly have had tiptank troubles or have heard of other pilots who have. Our accident files contain numerous cases wherein both tiptanks failed to feed, setting up a situation which the pilot couldn't handle.

In some instances the aircraft engine flamed out before the pilot could find a place to set 'er down. In other cases, the pilot tried to land with both tips full and landed short of the runway because he didn't fly the aircraft at a higher airspeed commensurate with the heavy fuel load. In still other cases the aircraft was landed at the proper airspeed, but the pilot was unable to stop the aircraft on the runway. He either overshot the landing or attempted landing on a runway which was just too darn short for the T-Bird with this fuel configuration. I could go on and on, but let's stop now and figure out what other choices were available to the pilot in the above instances. Three choices come to my mind immediately:

1) Correct the malfunction and proceed as planned. If unable to effect proper feeding of the tiptank fuel, then you must —

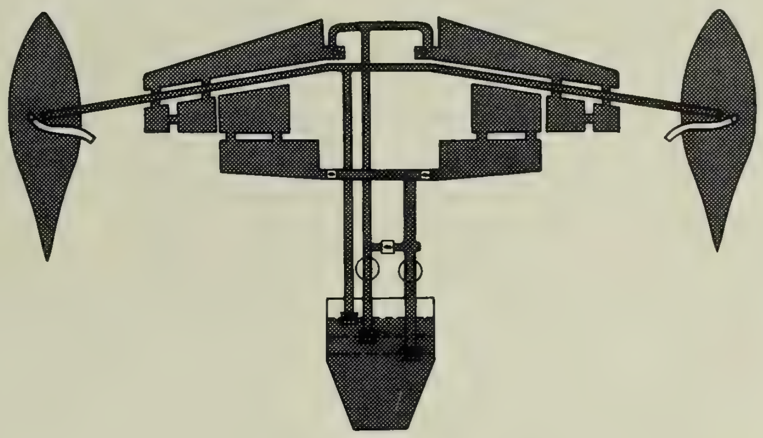
2) Change your present flight plan and proceed to the nearest suitable airport which you can reach safely without danger of a flameout en route, and then —

3) Determine whether you have enough runway available to land with two full tiptanks. If the answer is no, jettison the tiptanks in a designated area or other suitable place and make a normal landing without tiptanks.

Some of you may ask, "How do you get both tiptanks to feed during flight?"

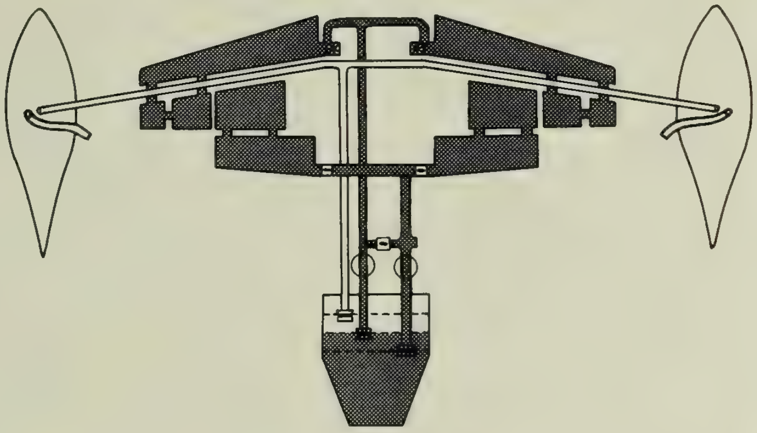
Analyze the problem carefully. If the tiptank fuel warning light is on, normally it means that the tanks are not being pressurized properly. In this event, there is little that you can do except proceed as outlined in (2) and (3) above. If the tiptank warning light is not on, the tiptanks are pressurized, but something is restricting fuel flow from the tiptanks to the fuselage tank. This something is usually a *stuck tiptank fuel float valve.* If it is a stuck float valve you have no problem. All you have to do is figure out some way to move the valve, and you're back in business. The best method of dislodging the valve is to slosh the fuselage tank fuel in such a manner that it will strike the float valve and move it back to its proper position. This can be accomplished by turning on the leading edge fuel tank switch and filling the fuselage tank as high as possible. The reason for this is that the tiptank float is located at the highest point in the fuselage tank, with the leading edge tank float valve at the next high-

Diagrams show fuselage tank fuel levels with tips, leading edge and wing tanks feeding.

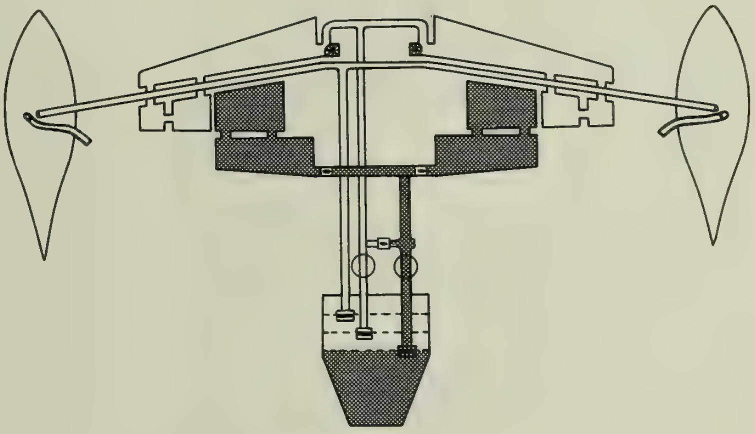


Above, note fuselage tank level when all tanks are full.

Below, note fuselage tank level when tiptanks are empty.



Below, note fuselage tank level with tips and leading edge tanks empty.



est level, just below the tiptank float valve. However, in the T-33A, SN 53-4886 and subsequent series, the wing tank float valve is the next highest valve. In these aircraft, turn on the wing tank fuel switch to fill the fuselage tank as high as possible.

After the fuselage fuel gage indicates that the fuselage tank is at its highest level, gently lower the nose of the aircraft straight ahead and make a slightly accelerated pullout, imposing approximately two positive G. After the pullout, level off gently, being careful to avoid negative G with a resultant flameout. Do this several times. As you bob up and down, the fuel in the fuselage tank will slosh back and forth and usually will dislodge the stuck float valve.

Next, turn off the leading edge or wing tank switch, whichever one you used, and check to see if the tiptanks are filling the fuselage tank. If the fuselage fuel gage indicates that the tank is filling, then your troubles are over. A note of caution, however, while you are bobbing up and down across the sky, stay on a heading which will take you to the nearest suitable airport. Utilize your internal fuel load judiciously and use maximum range power settings. It may be possible that you can't get the tiptanks to feed because of some other malfunction.

While we're on the subject of simultaneous malfunction of both tiptanks, let's go back along the flight path and see if we can find out exactly *when* they began to malfunction. In many instances the tiptanks were not feeding at time of takeoff! Then why did the pilot take off?

In many T-33 checklists used throughout the Air Force the emphasis appears to be placed on the tiptank warning light rather than on checking the fuselage fuel tank indicator. Many pilots, particularly during formation takeoffs, quickly will give their flight leader the OK sign for takeoff at the moment that the tiptank warning light goes out, signifying pressurized tanks. This is not a good habit to acquire. It is equally necessary to insure that tiptank fuel positively is being fed to the fuselage tank! Cross-check the fuselage fuel gage to see if you're getting fuel from the tips before takeoff.

When one tiptank fails to feed during flight, the situation is more serious. Usually there is nothing that the pilot can do in flight to get it to feed. In this case it is evident that the tiptank float valve is operating properly, since one tank is feeding. The trouble then usually can be traced to a loss of pressure within the malfunctioning tank, caused by a loose fuel cap or a loss of pressure or restriction within the fuel line, sniffle valve or pressure regulator. There are still a few people who teach various home remedies which they claim will cause the tiptank to feed, provided that the malfunction is not caused by a loose fuel cap. And there may be a very few instances where these remedies work, depending upon the circumstances. The only recommended procedure, however, is to close the cabin pressurization vents. Pressurization for the cockpit and tiptanks is obtained through inter-connected lines leading from the engine compressor. If insufficient pressure is being routed to one or both tiptanks, it is sometimes possible to increase the pressure to the tips by shutting off the cockpit pressurization vents. The windshield defroster control valve should also be closed. This enables all available pressure to be diverted to the tiptanks. Do not attempt any steep turns, accelerated pullouts or any unusual maneuvers, they won't help.

If the tiptank malfunction cannot be corrected, jettison the full or partially full tank in a suitable area. If you cannot release the tiptank and lateral control cannot be satisfactorily maintained down to an airspeed of 130 knots, leave by the nearest exit. If a landing is absolutely necessary, slowfly the aircraft and determine the lowest airspeed at which you can safely maintain lateral control. Do not turn off the aileron boost control. *Do not stall the aircraft!* Do not make steep turns. If you have to turn at all, use only a very slight bank during the turns. Do not bank into the direction of the partially full tank or you may not be able to lift the wing for rollout. If there is a fuel differential of 100 gallons or more between the left and right tiptank, the aircraft cannot be controlled laterally except at high speeds. Do not attempt to land with this differential unless it is impossible to bail out.

The Wright Air Development Center is presently testing and considering a dump valve installation for each tiptank which will enable the pilot to dump the fuel in a few seconds. Until that time, treat the tiptanks with the greatest of respect. Check those fuel caps closely. When you encounter a tiptank which feeds more slowly than the other during flight, write it up so that maintenance people can correct the trouble before it becomes the cause of an emergency.

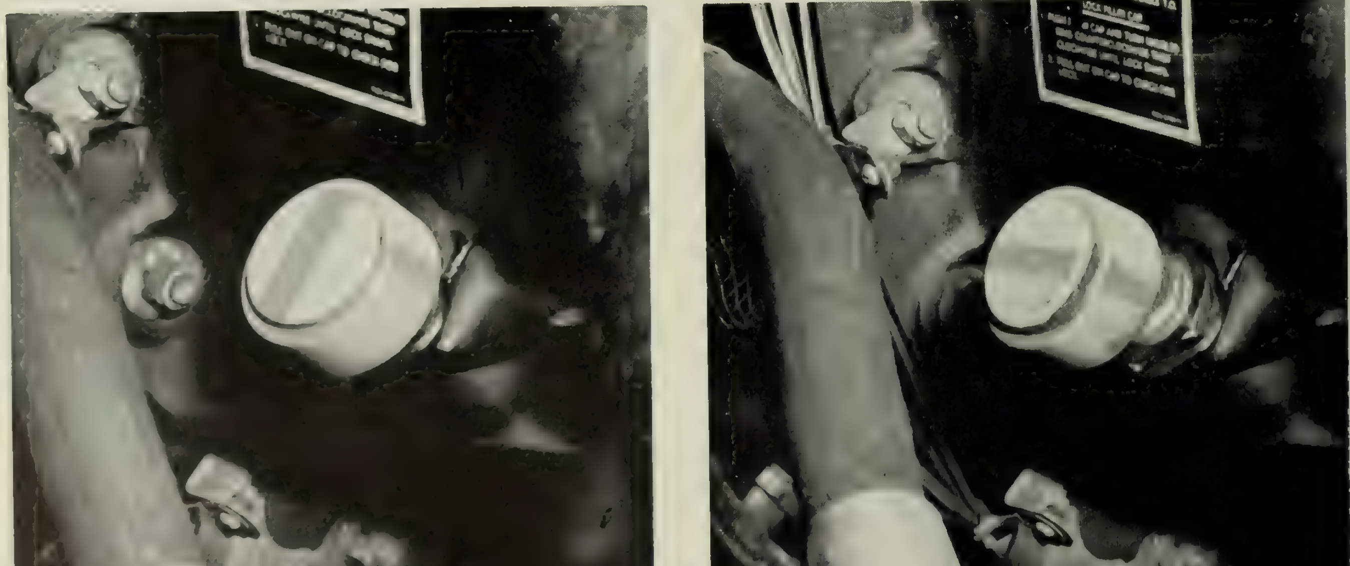
Another little item which has tripped up many a T-33 pilot is mismanagement of fuel. Some of the oldest pilots have had emergencies because of a simple malfunction of the liquidometer float arm in the fuselage fuel tank.

There are several cases in the files about the pilot who neglected to cross-check the fuel warning lights against the fuel totalizer and fuselage fuel gage. In a couple of instances, the fuel warning light blinked on over the tiptank switch or main wing tank switch, but the pilot was patiently waiting for the fuselage fuel gage needle to drop down from the full mark. These guys were rudely awakened by a strange "blurp," and then came the sheer and utter silence denoting flameout.

These pilots had accidents because they weren't sharp enough on airstart procedures or because the flameout occurred at too low an altitude. Don't let it happen to you. Keep track of your fuel at all times. Every time a set of fuel tanks goes dry and the warning light comes on, check the totalizer and the fuselage fuel gage to see if they all agree.

For example, I set the fuel totalizer at 810 gallons when the aircraft is fully serviced with fuel, figuring that approximately three gallons will be used for the engine start which will not be reflected on the totalizer. The tiptanks hold 460 gallons. If I didn't touch another fuel switch in the cockpit, I'd expect the tiptanks to register

Left, the oil cap is down and in place on filler neck but not locked. Note the position of the painted aligning marks, indicating an unlocked condition. Right, painted aligning marks now indicate a locked condition, but oil cap is loose on filler neck. Cap must be fitted tightly, with markers aligned.



empty when the fuel totalizer had dropped to approximately 350.

I check the leading edge and wing tank fuel pumps prior to takeoff, however, by pumping approximately five gallons with each set of pumps into the fuselage tank. Now I know that the totalizer should hit close to 340 when the tips go dry. If the totalizer and the tiptank light don't check with each other, I'm immediately suspicious. I make the same check when the wing and the leading edge tanks register empty.

It's always possible for one of the fuel boost pumps to go out and the malfunction will not become known until the pertinent fuel warning light comes on over the leading edge or wing tank switches. When this happens, subtract the total amount you normally would have when the light comes on from the amount now registered on the totalizer. This will be the amount no longer available.

For example, you know that when the main wing tank fuel is exhausted, the totalizer should read approximately 195. If the wing tank warning light comes on when the totalizer reads 250, you had better plan to land earlier than you anticipated, because you are now 55 gallons short.

Now on to a couple of little items which cause accidents, but definitely. First, there's a slight headache known as the oil filler cap check. The oil cap check has presented such a problem that a Flight Safety supplement T.O. (IT-33A-1W) has been printed to insure that pilots are aware of the importance of the filler cap security. The oil cap check has been a part of the visual inspection requirements in the T-33 dash one handbook for a long time, but we still have instances of pilots groping for the runway with a cockpit full of dense blue oil smoke.

If you have long arms, you probably have no real difficulty in reaching down through the plenum chamber to check security of the oil cap during the visual inspection before takeoff. If you have short arms, you might belong to the fraternity of pilots who can barely touch the oil cap, much less check it for security. If you are short-armed, you are one of the guys most likely to have an accident because you didn't check it. Don't get lulled into a false sense of security. Do whatever it takes to insure that the cap is secured. Remember that it is possible for the yellow aligning lines on the oil filler neck and oil cap to be aligned when the cap is actually unfastened. The only positive check is to grab the cap and see if it comes off. If you can barely manage to touch the cap, don't jiggle it around with your fingers; you'll run the danger of unlocking it. If necessary, have your crew chief open up the right upper or lower engine access door so that you can make a positive check of the cap. Stay at that spot until the airlock fasteners are again hooked up and recheck them for security.

The latest information from Wright Air Development Center indicates that a curved extension is being devised for the oil filler neck and will be forthcoming in the near future. In the meantime, be smart. REACH FOR THAT OIL CAP!

In addition to the check of the oil cap, you can further increase your assurance against smoke in the cockpit by properly closing off the "foot warmer" and "head warmer" vents in the rear cockpit during the visual inspection prior to engine start. If you're the student pilot and the guy in the back seat is the IP, disregard the vents. He'll close them if smoke enters the cockpit. But if you are going solo or the guy in the back is other than an experienced T-33 pilot, be sure to shut off the vents in the rear cockpit. If smoke comes pouring in, all you have to do is close your own front cockpit vents and dump the cabin pressure and you have no sweat. Incidentally, I recommend that the head warmer vents in both front and rear cockpits be closed during takeoff. It's not easy to fly the airplane with your left hand while kicking at the foot vent levers and the cabin pressure dump valve, then reach behind you with your right hand for the not-easily-accessible head vent lever.

Before you take off, run the engine up to 100 per cent rpm and make your routine check of engine instruments and insure that tiptanks are feeding. During this time, look down at the foot warmer vents and check for smoke. If you're on 100 per cent oxygen, as you should be, you probably wouldn't smell any smoke that might be entering the cockpit.

Another essential item in the T-Bird is a good flashlight! It might be a great temptation to slip a pencil type flashlight in your flying suit or jacket sleeve at night, but don't do it unless you back it up with a reliable GI flashlight or its equivalent. Your pencil light will serve you in the cockpit, but it won't help you when you're wondering about the position of the aileron trim tab on a dark night. A good strong flashlight will be worth its weight in gold if you should ever experience uneven tiptank feeding under these conditions.

In conclusion, a couple of other tips might bear mentioning. One of these concerns the delicate subject of ballast in the nose of the bird. If your aircraft has an APX-6 radio set and gun ammunition cans installed in the nose, you won't be concerned with any ballast problems.

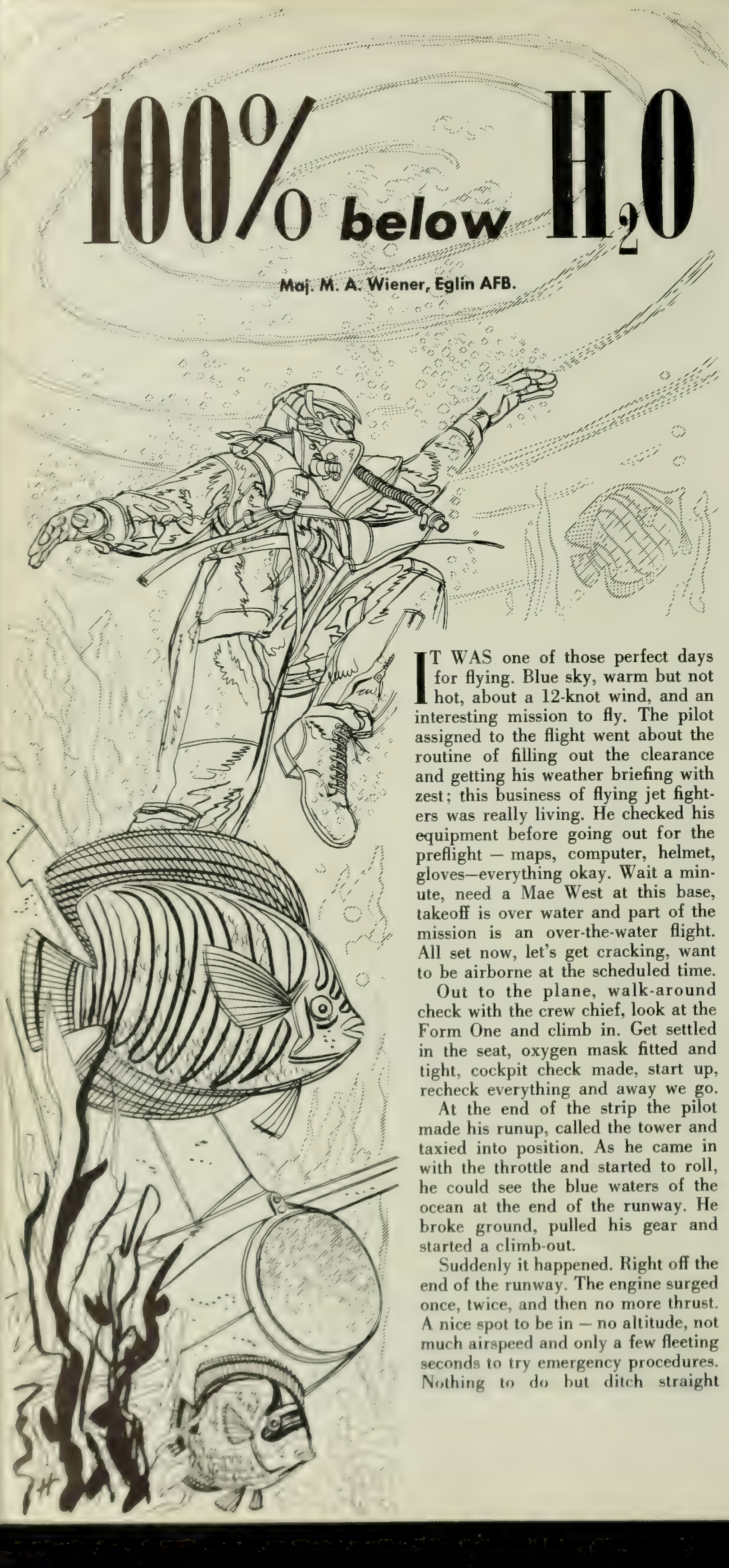
However, if your T-33A is used primarily as an administrative aircraft or for other duties not involving some phase of gunnery, it is possible that the ammunition cans and the APX-6 may be removed. In this event you may be the unlucky one to attempt takeoff with excessive personal baggage crammed into the nose section. With the ammunition cans and APX-6 removed, the T-Bird can hold two nearly-full B-4 bags plus several other bulky items. With this extra ballast the nose gear has a decided tendency to remain glued to the runway during takeoff. If it is absolutely necessary to make a flight with this much baggage in the nose section, it is recommended highly that you weigh the baggage and delete a corresponding amount of lead ballast.

The last tip is for those pilots who might have occasion to sit in the front cockpit of the T-33A and observe while someone is under the hood in the rear cockpit. There have been a couple of accidents because neither pilot noticed uneven feeding of the tiptanks. The pilot in the rear cockpit can't always detect whether he is using excessive aileron trim while he is under the hood. If you are in the front cockpit, keep glancing to the left and maintain a close watch on the aileron trim tab. If you detect an unusual amount of trim, take control of the aircraft for a minute and make a check to see if you're having tiptank trouble or plain pilot technique trouble. If you don't, you may be in for a terrific thrill when you ask the other pilot to demonstrate a steep turn while under the hood.

We all know that the old T-Bird is a good, reliable piece of flying machinery. But, even as you and I, sometimes it can get a little out of whack and not function properly. Most of you may never have to use these tips but remember, most of them were learned the hard way, and this experience passed on to you is like money in the bank. ●

# 100% below $H_2O$

Maj. M. A. Wiener, Eglin AFB.



IT WAS one of those perfect days for flying. Blue sky, warm but not hot, about a 12-knot wind, and an interesting mission to fly. The pilot assigned to the flight went about the routine of filling out the clearance and getting his weather briefing with zest; this business of flying jet fighters was really living. He checked his equipment before going out for the preflight — maps, computer, helmet, gloves—everything okay. Wait a minute, need a Mae West at this base, takeoff is over water and part of the mission is an over-the-water flight. All set now, let's get cracking, want to be airborne at the scheduled time.

Out to the plane, walk-around check with the crew chief, look at the Form One and climb in. Get settled in the seat, oxygen mask fitted and tight, cockpit check made, start up, recheck everything and away we go.

At the end of the strip the pilot made his runup, called the tower and taxied into position. As he came in with the throttle and started to roll, he could see the blue waters of the ocean at the end of the runway. He broke ground, pulled his gear and started a climb-out.

Suddenly it happened. Right off the end of the runway. The engine surged once, twice, and then no more thrust. A nice spot to be in — no altitude, not much airspeed and only a few fleeting seconds to try emergency procedures. Nothing to do but ditch straight ahead — can't seem to get the canopy off — have to try manually after setting her down. Quick call to the tower stating that this is an emergency, that he is ditching off the end of the runway.

The man in the tower alerted the crash circuit and watched as the aircraft settled into the water amid a screen of spray. The plane floated, low in the water, but the pilot couldn't seem to get out. Gradually it sank beneath the surface. A minute passed that seemed to stretch into hours; another; two, five — a helicopter hovered over the roiled water but it was too late now, or was it? Almost 10 minutes after the plane disappeared, sudden activity could be seen in the water. The helicopter lowered the sling and pulled up a dripping object. Couldn't be the pilot — no man could stay under water for over nine minutes and live, or could he?

Fifteen minutes after the emergency occurred the pilot was standing in base operations, dripping, bedraggled but unhurt. He had spent a good portion of that time underwater but he got out with only a ducking. The question might well be asked, "Does the Air Force have some new Jules Verne-type equipment that enables a man to breathe under water?"

The answer is no! The hero of our hypothetical case (but it could have happened) only had to do two things in order to keep breathing under water for over nine minutes, or considerably longer if necessary.

*He had to have his oxygen regulator set on 100 per cent and he had to have a good, tight fit of his oxygen mask.* Nothing else. No special equipment, no newly designed breathing apparatus, just a standard issue Air Force A-13A or A-14 oxygen mask and the knowledge of how to use it if an occasion arises.

The possibility of emergency underwater breathing, using the standard oxygen equipment installed in U. S. Air Force aircraft, was first brought to the attention of the Air Force through a research report by L/Cmdr Arthur L. Hall, USN, assigned to the U. S. Naval School of Aviation Medicine. His report was published in July 1952. It pointed up the fact that it was possible for an aircrew member to breathe under water by using the aircraft oxygen equipment after sinking with his aircraft following a ditching.

Hall's report summarized a series of experiments he made using standard oxygen equipment attached to an airplane seat. The experimental unit and subject were dunked in Pensacola Bay over the side of a boat. All possible attitudes in relation to the water surface in which a crewmember might find himself were used by attaching lines to the bottom of the seat. The depth of the oxygen regulator in relation to the man's body was also varied, while each of eight subjects was submerged to a depth of 33 feet in one series of tests and to 65 feet in another.

Hall found that varying the position of the regulator affected a man's ability to inhale and exhale. When the regulator was above the base of the neck, negative pressure was built up inside the mask and made it more difficult to inhale. When the regulator was lowered to a position below the base of the neck the subject had some trouble exhaling because of the built-up positive pressure. The best regulator position was found to be as near the base of the neck as possible.

The Naval School of Aviation Medicine stated that the results of these experiments showed, "That if a pilot keeps his oxygen mask on and connected to his aircraft oxygen supply, with his regulator on DILUTER OFF (100 per cent) when a water landing is imminent, his oxygen equipment should protect him for an extended period of time if normal escape from the airplane is impossible for mechanical reasons, physical injury or if he loses consciousness on impact."

As so often happens, sister services have much the same operational problems in many theaters. The Air Force and the Navy both carry out extensive overwater missions, and the possibility of an unexpected dunking is an ever-present possibility in the operations of both.

Consequently, the Air Force decided that a series of experiments paralleling those of the Navy were warranted in order to test AF equipment and to determine the feasibility of its use under similar conditions. Headquarters USAF directed that the Air Force Operational Test Center (APGC), Eglin AFB, assume the responsibility for an exhaustive study and analysis of the possibilities of underwater survival.

Careful evaluation of findings and incorporation of them into sound recommendations that could be disseminated to all Air Force agencies concerned were also directed.

*Flying Safety Magazine* was alerted and asked to be the medium for spreading the word, and at Eglin and the Pensacola Naval Air Station, the editors had an opportunity to learn first hand just how well this newly discovered system of self-rescue works.

The one primary requirement for self-preservation following an emergency ditching is clearly spelled out in the AFOTC recommendation that followed evaluation of the test program. It could well be covered in a single word. *Training!* Possibly that sounds like a disagreeable word to many of you. Just remember though, a few minutes of the proper training may keep you in business long enough to collect that retirement check one of these fine days.

The Air Force Operational Test Center has this to say about the feasibility of underwater breathing: "Use of standard installed equipment will work beyond any manner of doubt. We recommend, however, that an indoctrination program be initiated in the use of this standard oxygen equipment for emergency breathing under water for all rated personnel and aircrew members. First hand knowledge is superior to theoretical discussions, and in knowledge lies ability."

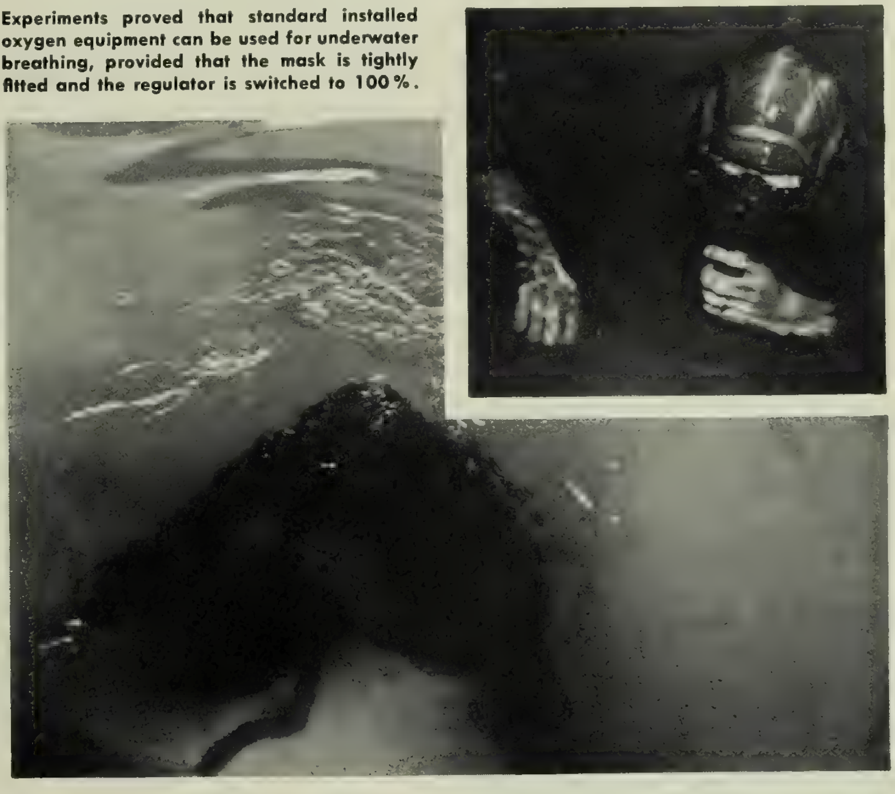
In commenting on the test program, Colonel Walter B. Putnam, Commander, Air Force Operational Test Center, said, "These tests and their results have shown that the Air Force has a new capability for a piece of presently installed equipment at no additional expense and with no additional weight penalty. It requires only the knowledge of how to use it, which, in turn, involves training of aircrews in this emergency underwater breathing technique.

"There is no question that in many instances this new technique can and will save the lives of Air Force personnel during ditching emergencies, if properly employed."

Basically, there are four factors that must be considered and understood when using installed oxygen equipment for underwater breathing. First and foremost, it is mandatory that the oxygen mask be fitted properly. If you're spending a goodly part of your time tooling around the blue at high altitude, it's a cinch that your mask will fit properly. If it fits upstairs it will do the job under water.

The next factor may be a bit on the psychological side and is a lot easier to recommend than actually do, but, if you're ever faced with an actual ditching and you've got to ride the old blow-torch down for a few feet under the drink, then it's a *must* that you remain calm. Easy to say? You bet. Hard to do? You bet again, and

**Experiments proved that standard installed oxygen equipment can be used for underwater breathing, provided that the mask is tightly fitted and the regulator is switched to 100%.**



we'll raise you. However, if you are given the chance actually to try out the system, you'll be a believer too, and that's why we're stressing the necessity for training.

The third must on this list is that of setting the oxygen regulator on 100 per cent. You've got to do it, even if time is short. If you'll stop and think for a moment you'll remember that with the regulator on DEMAND you're getting a percentage of oxygen and air, mixed properly for the existing altitude. That's great while airborne but not worth a tinker's you-know-what when you suddenly subject the mixing valve to $H_2O$. Get it? Okay, remember, *the regulator must be set on 100 per cent oxygen.*

The Navy "Dilbert Dunker" is a mocked-up cockpit used to simulate ditching conditions.

Fully clothed, wearing a chute and Mae West, students hit water at approximately 27 knots.

Upon contact, the "Dunker" flips over and sinks. Students free themselves and swim out.

The last factor involves the bailout bottle. Most of you automatically will think of that little beauty as a first-aid helper in case of an unexpected dunking.

The only advice we can give you on that score is *don't use it.* The reason is very simple. It won't work. The bailout bottle cannot be used under water, because normal breathing will reduce the pressure in the breathing tube enough to allow water to enter the one-way valve at the end of the oxygen hose.

A series of controlled tests were conducted both in a pool and in the Gulf of Mexico. Admittedly, the AFOTC people didn't deliberately fly a few first-line fighters into the drink in the interest of science, but it was possible to simulate actual ditching conditions in some mighty wet water, and a lot of lessons were learned.

Almost all of the volunteers suffered mild attacks of claustrophobia at first. It's a perfectly natural reaction, and all of us are subject to the same feelings when faced with the realization that we're suddenly going to be removed from our natural environment and placed in a position where all light, air and personal contact is something no longer available. Although this isn't strictly true, the feeling is there. It's a case of the unknown, and that's our worst enemy.

To the man who ditches, the shock of entering the water is sometimes a bit severe. However, he now has the most important factor in his favor. He can still breathe. Maybe the impact and the cold will take his breath away momentarily. Probably it will. But, as soon as he starts to function normally again, he won't be faced with the horrible necessity of holding his breath (if there's any left to hold), and that spells the difference between a successful evacuation of the aircraft and failure.

It should be noted that both test volunteers and pilots who have ditched report that it is somewhat difficult to breathe as the aircraft (or test seat) descends lower and lower. This, however, is natural, and there's no reported case of anyone giving up the attempt even though it was a trifle difficult.

It has also been found that the deeper one descends, the more rapid the breathing will become. But, with the diluter on 100 per cent and things pretty much in your favor, go ahead and puff.

Most of us have done quite a bit of swimming and diving at one time or another. Probably in the old mud hole when young and in the average pool a bit later in life. The point is that normally you've had pretty good vision while under water. Don't let this fool you. If you ever dunk a plane in deep water, you're going to be blind as the proverbial bat after sinking for about 10 feet. Consequently, you'll have to go through all of the releasing motions by feel. This may sound silly too, but remember, you must disconnect the hose last.

The Air Force Operational Test Center would like to see a very comprehensive underwater training program aimed at those who might be saved by knowing how to use their oxygen equipment underwater. The recommendation is that a unit be employed similar to the famous "Dilbert-Dunker" currently used by the Navy. There's a good reason for this feeling too. Dilbert really simulates many of the factors encountered during an actual, unexpected dunking. The shock is there, snapping the driver against the belt. As the simulator hits the water, it flips over and starts to sink in an inverted position. And, it's right then that the pilot has to get busy, unstrap himself, kick free and then swim to the surface.

Such training establishes two very important impressions. Personnel learn that they can ditch if necessary and ride the plane down while they get themselves free of the aircraft and at the same time, they can continue to receive life-giving oxygen from the system. Once such a demonstration has been experienced, it will never be forgotten. Knowledge then takes the place of blind, unreasoning panic, and a successful evacuation of the plane can be an assured fact.

Interestingly enough, all flight personnel at Eglin AFB are currently being indoctrinated in this new survival program by a series of lectures included in the physiological training program, and in the near future will participate in simulated ditchings.

The best thing about this entire test program or programs as established by the USAF and the Navy is that the findings are not based on experimental data alone. This is one time when skeptics can't say, "Sure, it sounds great, but all the tests were made under ideal, controlled conditions. Things might be different if a pilot is faced with an actual ditching and has to go down with his aircraft."

There are two known cases, both involving Navy pilots, where the men went down with their aircraft, used their standard installed oxygen equipment, and got out okay.

One pilot, flying a Cougar, crashed into the water a short distance from his carrier. The aircraft hit at about a 45-degree angle of attack and sank immediately. The pilot got out of the plane after it had sunk about 15 feet and after being submerged for several minutes.

In relating how he got out he stated, "While I was struggling to clear the cockpit, I had 100 per cent oxygen on and could feel the positive pressure on my face."

Another pilot, flying a Panther, had a similar experience. His plane hit the water in a nose down attitude and sank in an inverted position. He was able to get out only because he was given enough additional time to disentangle himself from his aircraft as it was sinking. Without a good fit on his mask and the regulator on 100 per cent he would have drowned.

In describing his experience the pilot said, "After the initial shock of the crash, I opened my eyes and saw only white, foaming water. I reached with both hands to unfasten my safety belt and shoulder straps. While doing this, I experienced considerable turbulence and pressure on my eyes and ears. I thought I had cleared the cockpit after being tossed back and forth but my chute caught on something and pulled me deeper. Just as I started for the surface, I struck some part of the aircraft. I finally reached the surface and bobbed under again momentarily. I treaded water and began looking for the helicopter."

On the other hand, research has turned up some cases where it is definite that if the pilots involved had been aware of the full capabilities of their oxygen equipment they would have survived.

In one instance the pilot of a fighter lost his engine shortly after takeoff. It happened so quickly he was unable to retract his gear. The aircraft hit on the wheels, bounced and landed in a shallow pond. Upon contacting the surface, it flipped and landed on its back in about five feet of water. The canopy stuck and the pilot was unable to get out of the plane. The crash crew was able to extricate the man in less than 15 minutes after the plane hit the water, but it was too late — he had drowned.

In a similar accident, the pilot of a World War II fighter ditched in a swampy area. The plane was observed to go down, and help arrived in a few minutes. When the rescuers arrived, they found that the plane was on its back in a few feet of water, with the canopy resting on the muddy bottom. Although the pilot was soon pulled from the water, he did not survive.

A third pilot, who ditched in the ocean, was more lucky. His plane sank immediately after ditching, but he was able to evacuate the aircraft at an estimated 30 to 40 feet. He believes that if he had known that his oxygen equipment would have enabled him to breathe under water, he could have gotten out much sooner. He commented, "I struggled furiously, trying to free myself from the cockpit. I remembered to hold my breath but felt frantic at being trapped in a sinking aircraft. I didn't take the few seconds necessary to plan my actions — just tugged and pulled haphazardly to get free." He was fortunate to pull loose, although dragged deep enough to rupture an eardrum in the process.

In the first two instances the pilots could have been saved if the emergency underwater breathing technique had been discovered at the time of their accidents. And in the third case the pilot could have been spared a harrowing few minutes that he will never forget.

Incidentally, a word of warning to you skin diving aficionados. This equipment is not recommended for underwater fishing or diving. Salt water corrodes the regulator and will cause the rubber diaphragm to deteriorate after initial use. And this doesn't even consider the physiological aspects of using oxygen over long periods of time or the cost of the oxygen and equipment. The equipment is invaluable in an emergency but just don't try to use it to furnish the *piece de resistance* at a fish fry. ●

**Maj. Murray A. Wiener**

Chief, Equipment Branch
Support Services Div., AFOTC

A native of New York state, Major Wiener has spent a large part of his life in the Arctic and Antarctic wastes.

During 1937-38 he was with the MacGregor Arctic Expedition in Northwest Greenland. 1939 saw him journeying to Little America with Rear Admiral Richard E. Byrd, and he didn't return to civilization until May of '41. Early in 1943 the Army Air Corps selected Wiener to establish a rescue organization for the North Atlantic Wing of ATC and this was followed by a similar chore for the Alaskan Wing.

The years of 1947-48 found him back in the Antarctic as an Air Force observer for the Navy's OPERATION HIJUMP, and following this little stint he went to the Alaskan Air Command as Chief, Arctic-Polar Branch where he officiated as project officer for a number of training films dealing with Arctic survival.

Finally, he managed to get to the ZI for a tour of duty and wound up in Hq USAF as Chief, Flying Services Branch, Support Services Division, DCS/D, and in November of 1952 was reassigned to Eglin AFB.

# ★ WELL DONE ★

## CAPT. METZROTH and CAPT. ROBERTS
### 809th ABG, Mac Dill AFB

Captain Robert J. Metzroth was the IP on a B-29 with a student pilot in the left seat. While the student pilot was making a hooded instrument takeoff, number four engine ran away, but an airspeed of 120 mph had already been attained, and the aircraft was committed to takeoff. Attempts to control the engine with the propeller toggle switch were unsuccessful as the aircraft became airborne. Captain Metzroth had taken over control of the aircraft, and number four engine was feathered since it was overspeeding beyond design limits. At this time runaway turbos occurred on both number two and three engines.

Captain Metzroth was unable to gain altitude because of the limited power conditions, but a decision was made to avoid a crash landing, if possible, due to the congested area and rugged terrain. Landing gear and flaps were retracted and Metzroth was able to keep the B-29 airborne at an altitude of approximately 50 feet. Barely missing

## CAPT. FRANK F. JENKINSON
### 3510th FTW, Randolph AFB

It was a routine, in-flight refueling training mission. Captain Jenkinson was in the right seat of the KC-97 with a student pilot at the controls. Following 22 hookups, both wet and dry, Captain Jenkinson was informed that the B-47 recipient was going to drop back to exchange crew positions before resuming training. While waiting, Captain Jenkinson felt a severe impact.

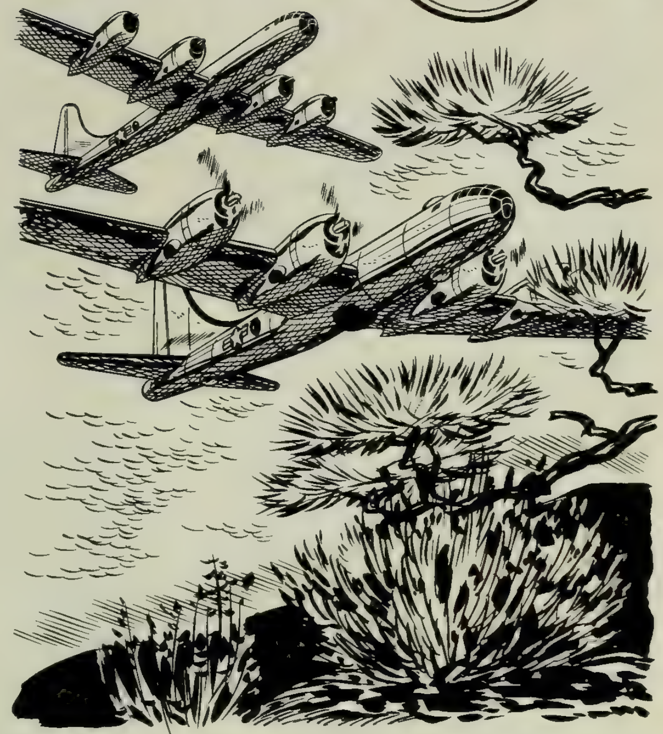
He looked out the right window and saw that the B-47 was up close and had struck the tanker's right wing. The No. 4 propeller had received extensive damage, resulting in severe vibration throughout the aircraft. No. 4 was shut down and feathered but the vibration continued. It was assumed that the No. 3 propeller also had been damaged, and normal feathering procedure was carried out for that engine.

The tanker shuddered and fell off on the right wing at approximately 190 mph indicated. With the aid of the trees and other obstructions, he decided to attempt flying the aircraft through a series of low valleys ranging between the hills in an effort to gain altitude.

Captain James W. Roberts, IP of another airborne B-29, realized the predicament of the other aircraft and went to its assistance. Flying just above and behind the crippled aircraft, Captain Roberts radioed instructions on maneuvering the aircraft to avoid oncoming obstructions and high terrain. The airspeed of the crippled aircraft at this time was 130-135 mph, which was still below desired engine-out speed. The aircraft was at such a low altitude that the propellers were just above the tree tops.

By following Captain Roberts' navigating instructions and because of his superior knowledge of the aircraft, Captain Metzroth finally managed to increase airspeed to 170 mph and succeeded in accomplishing a wide 360-degree turn back to the field. All aircraft in the traffic pattern had been cleared from the area and the aircraft was brought in to a successful landing.

The skill and judgment exhibited by both pilots are evidence of their professional competence and proficiency.



student, Captain Jenkinson righted the aircraft, but level flight could not be maintained. Jenkinson remained in his seat to attempt to hold a level platform and ordered crew bailout. Following bailout of his entire crew, Captain Jenkinson found that he had some control of the aircraft between 190 and 200 mph. With No. 4 slowly windmilling in reverse, the pilot headed toward the nearest suitable airfield. The right wing dropped several times, but each time recovery was made and flight continued.

By lowering flaps in increments of five degrees, the pilot determined that with 35 degrees of flaps the aircraft could be controlled at 160 mph, gear down. He decided to attempt a landing. Captain Jenkinson put the aircraft on automatic pilot and moved to the left seat so that nosewheel steering could be available.

A wide descending approach was made for left-hand traffic, the pilot still holding 160 mph. The aircraft touched down and was allowed to slow considerably before brakes were applied. Approximately 40 minutes had elapsed between the time of collision and the successful landing.

Again knowledge and training paid off.

# Beginning of the N

IN CASE you haven't noticed, the B-25 has been undergoing a face lifting. The old girl is being rewired, refitted and, upon modification completion, redesignated the B-25N. She has taken on a little additional weight (some 600 pounds), but it's worth every pound of it in useful devices and pilot comfort.

To start with, the engine fire extinguishers are now located in the rear of each engine nacelle. There is a spring-loaded inspection plate located on the outboard side of each nacelle, designed to make checking for extinguisher pressure an easy task during your walk-around. The actuating switches in the cockpit are conveniently located to the right and left side of the control pedestal for the right and left engines respectively.

Another innovation is the installation of engine fire warning detectors. The fire warning light is located on the left side of the instrument panel, with a test switch on the pedestal.

The instrument panel is standardized, with the flight instruments logically arranged on the left, and the engine instruments on the right. Gone is the eye penetrating purple haze of the fluorescent lights during night operation. The new cockpit lighting consists of red lights installed in small shields over every instrument on the panel. There are three red side panel lights on both the right and left sides of the cockpit, along with two detachable, red map reading lights. For those of you who frequent areas of thunderstorms complete with blinding lightning, there is a white, overhead thunderstorm light located between the pilots.

For additional lighting there are four (two on each side) small red floodlights that light up the instrument panels and control pedestal so that you can really see what you're looking for. The quality of the new lighting is summed up in the words of one pilot, who stated, "This is the first time I have ever flown at night and been able to read any instrument on the panel with just a glance." Spare bulbs are readily available in an overhead storage case in the gunner's compartment.

The entire electrical system has been reworked and the various switches and meters rearranged. The electrical panel, formerly located in the gunner's compartment, has been condensed and moved to the copilot's panel just under the engine instruments. Now, the voltmeter, loadmeter, generator and inverter switches are within easy reach of the pilots. There are three panels of circuit breakers located in the gunner's compartment. Rheostats for the anti-icing equipment have been relocated on an overhead panel positioned between the pilots.

Individual heaters are located in the passenger, gunner and pilot compartments. Heater switches for each compartment are on the copilot's electrical panel. Three heater overheat-lights are located in the center of the instrument panel. Rheostats in each of the three compartments control the temperatures.

There are many other changes that will become apparent to the pilot upon entering the driver's seat.

One such change is designed to eliminate the possibility of actuating the wrong fuel shut-off valve in the event of an emergency. The valves, formerly positioned in-trail beside the pilot, are now located on the right and left sides of the control pedestal.

The landing light switches have been isolated on the control pedestal to prevent the possibility of inadvertently hitting the wrong switch during night operation.

Two seats complete with safety belts have been installed in the gunner's compartment and can be used for passengers, students or extra crewmembers. A new oxygen distribution system has been incorporated to provide four separate diluter demand type oxygen regulators in the pilot and gunner compartments. The regulators are positioned beside each of the four crew positions to facilitate individual regulation of oxygen by crew members.

The one additional change that you may run into, and one that radically alters the operating procedures and limits of the new "N," is the replacement of the Holley carburetors with Bendix carburetors. This particular modification is an innovation to the program, and was only recently initiated to help prevent possible engine flooding because of excessive fuel pressure. (See article entitled *Off For Landing* which appeared in the September issue of *Flying Safety Magazine.*)

Determining if the "N" you are about to fly has a Holley or Bendix carburetor is a good trick. It can be done without tearing into the engine cowling, but it is recommended that, until all the B-25s are Bendix equipped, the aircraft be placarded locally to indicate what carburetor is installed. Changes in operation of the B-25 resulting from this installation are important and should be reviewed by all crew members.

### Fuel Pressure Check

There is a change in the fuel pressure requirements. During engine operation, the fuel pressure should be 21-23 psi with a minimum of 17

and a maximum of 25 pounds per square inch. Prior to starting the engines, a preflight should be made to determine proper operation of the fuel booster pump system. To accomplish this check, the booster pump switch should be in NORMAL, and the fuel pressure gage should indicate 9 to 10 psi. Next, move the switch to the emergency position and check for a fuel pressure of 21 to 23 psi. It is important to remember that malfunction of the fuel booster pump system could be caused by excessive voltage, so be sure that the meter indicates approximately 28 volts.

### Carburetor Heat and Filters

The carburetor heat controls mechanically operate the carburetor air doors and have two positions, NORM (normal) and ICING. With the controls in the NORM position, the ram air doors in the center of the air scoops are opened to admit ram air into the induction systems. Moving the controls toward the ICING position, gradually closes the ram air doors and simultaneously opens the preheat doors from the preheat ducts.

Before the engines are started, a check should be made to make certain that the controls are in the NORM position. With the engines operating, and with the controls in the NORM position, the carburetor air temperature should be within 6°C of the outside air temperature. If a temperature differential of over 6° is noted, check the system to determine that the ram air doors are fully opened and the preheat doors fully closed.

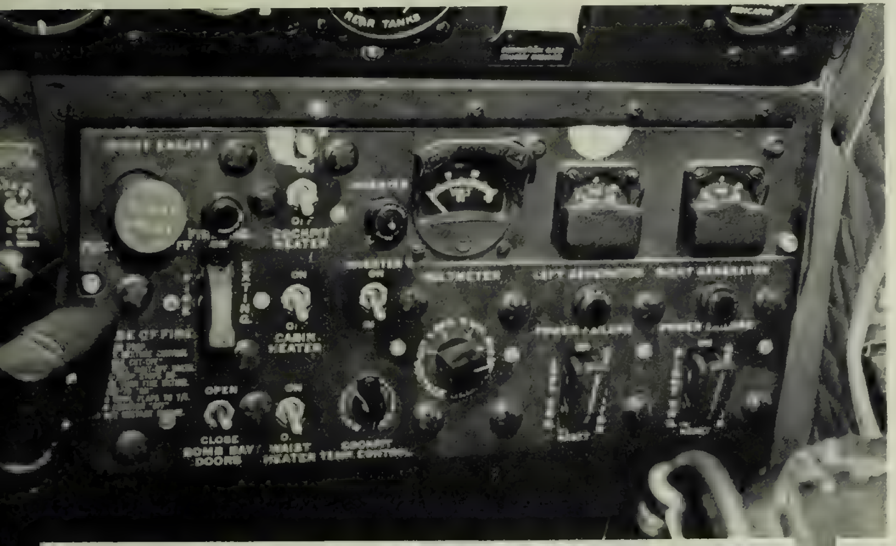
During engine runup, at 1800 rpm, move the controls to the ICING position momentarily and observe a carburetor air temperature increase.

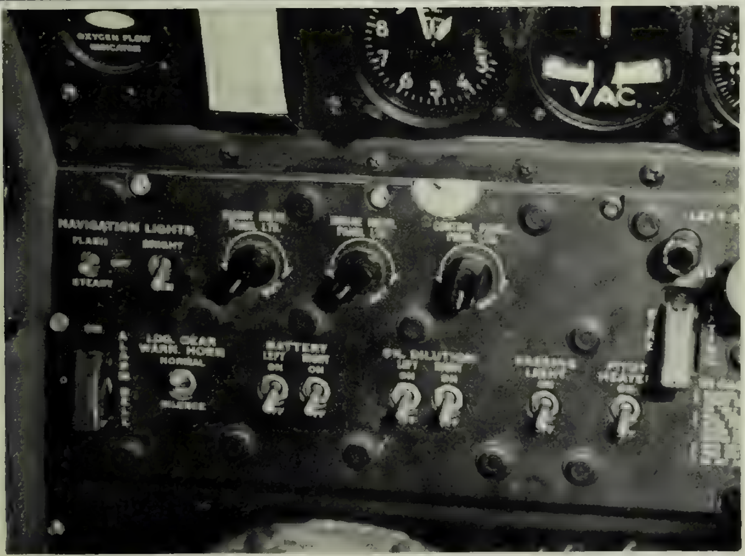
A filter has been installed in each carburetor air system which may be utilized by actuating the carburetor air filter switch located on the control pedestal. The switch, when moved from the NORMAL to FILTER position, hydraulically opens the filter doors and blocks off the ram air, admitting all the engine air supply through the filters. An indicator light located above the switch is illuminated when the switch is in the filter position. No carburetor heat is available when operating on filtered air as that portion of the scoop is blocked off by the filter air door.

Use of the filters has no great effect on engine operation up to the critical altitude of the airplane. For a given manifold pressure the engine will develop the same power with or without the filter in operation. The only instance when performance will be improved by using ram air instead of filtered air is when the throttles are fully opened and still higher manifold pressure readings are permissible.

The switch should be in the NORMAL position prior to starting engines. After starting, the engines filter operation may be checked by setting 30 inches of manifold pressure with

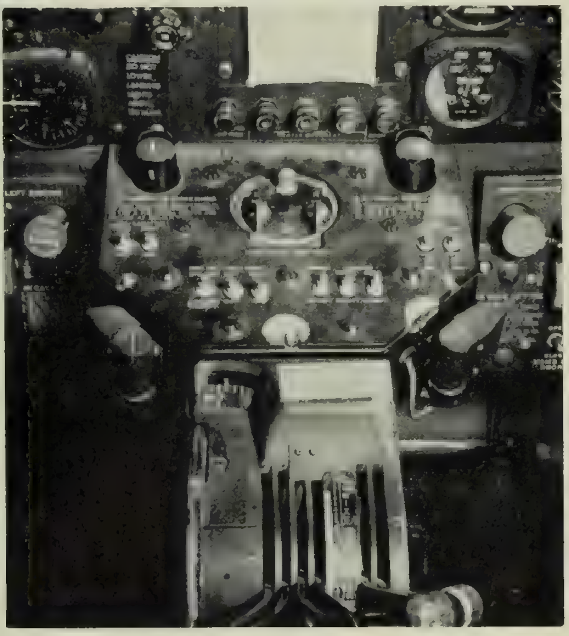
The electrical panel, formerly located in the gunner's compartment, has been condensed and repositioned on the copilot's panel. Generator, inverter switches now are more accessible.





Above, the pilot's panel has been redesigned to present a logical arrangement of necessary switches. Left, engine fire extinguishers are relocated in nacelles.

Switches on the pedestal have been rearranged, and fuel shut-off valves placed on either side.



the filter switch in NORMAL. When the instruments have stabilized, turn the filter switch to the FILTER position and note a decrease in manifold pressure of approximately ½ inch Hg. Return the switch to NORMAL and the manifold pressure should return to 30 inches Hg.

### Takeoff Power Technique

Full throttle stops are not installed on the Bendix carburetor and caution must be taken to prevent excessive manifold pressure during takeoff. Advance the throttles smoothly and stop them when the desired manifold pressure has been attained. At sea level the throttles should be advanced to a maximum of 44 inches Hg. For takeoff from fields above sea level, decrease the manifold pressure ½ inch Hg for each 1500 feet above sea level.

### Heat Procedures

It is recommended that carburetor heat be used for approach, landing and taxiing whenever the outside temperature is 12°C or lower. When cruising through icing conditions, the normal procedures apply. Caution should be exercised to never allow carburetor air temperatures to exceed 40°C, or detonation may occur.

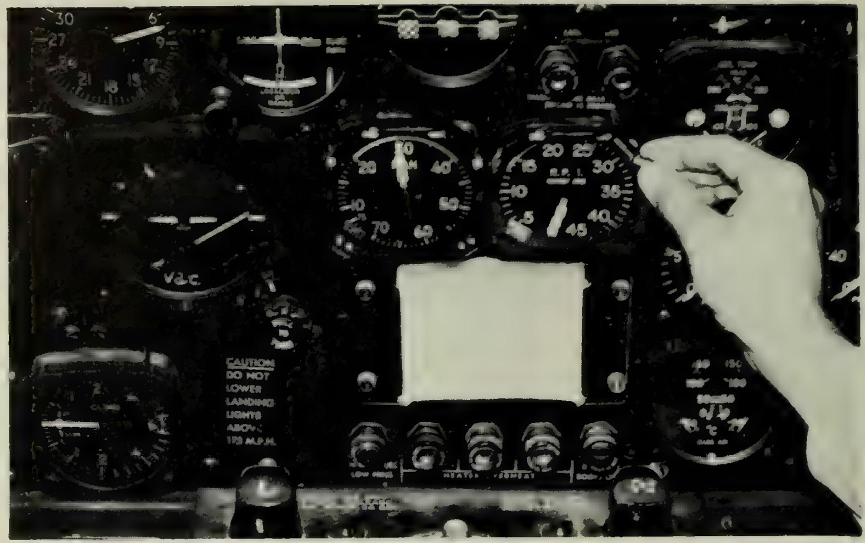
### Stopping Engines

The engine stopping process is the same as for other models with one exception. After placing the mixture controls in the cutoff position, do not advance the throttles as the engine stops. Advancing the throttles will actuate the accelerating pumps and inject additional charges of fuel into the induction system. This may result in incomplete engine cutoff, severe backfire or an induction fire.

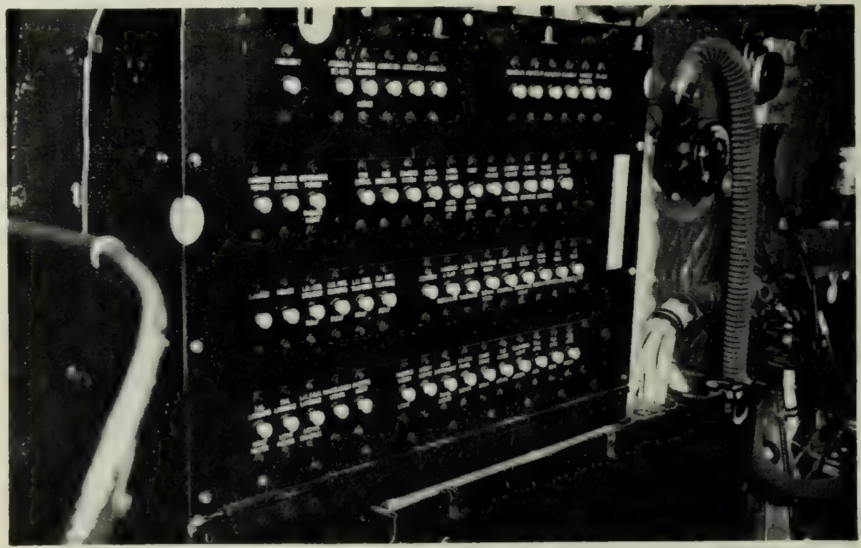
### Filter Malfunction

In the event of a sudden increase in manifold pressure (one to three inches Hg) during stabilized filter operation, leakage or a loss of hydraulic pressure should be suspected. If a loss of hydraulic pressure is experienced, the filter doors automatically return to the unfiltered position. When this occurs, the carburetor air filter switch should be returned to the NORMAL position immediately to prevent loss of hydraulic fluid.

All in all the new B-25 is quite an airplane. From the newly installed lighting equipment to the engine fire detectors, modifications were made with an eye to reliability, utility and greater comfort. ●

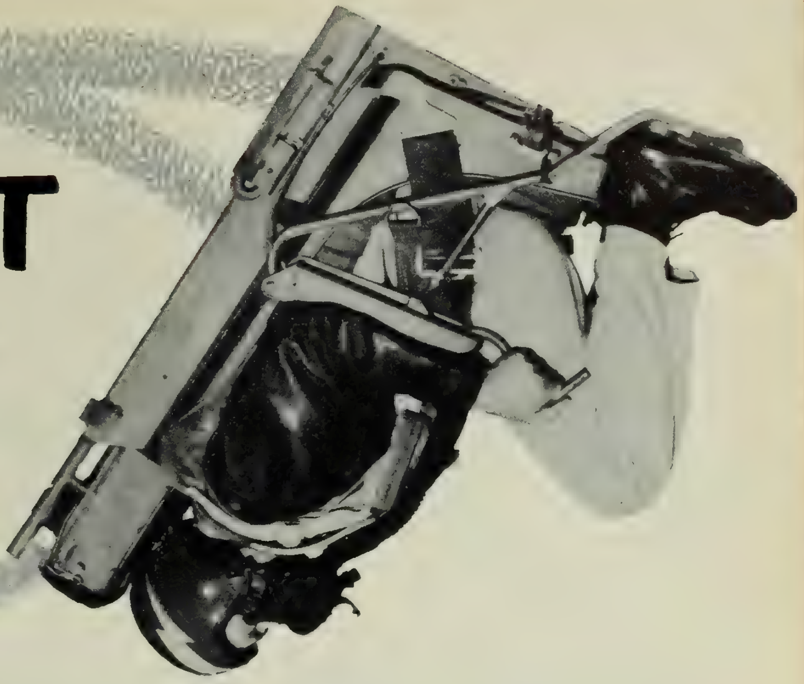


**New cockpit lighting consists of red lights installed in small shields over every instrument on the panel. Shields pull down to facilitate easy bulb replacement from handy overhead box.**



**Above, a main circuit breaker panel is located in the gunner's compartment. Below, two seats equipped with headsets, mikes and oxygen can be used for passengers, students or extra crew.**

# DON'T Just Sit There!



"THE ejection itself was no sweat. Remembering a friend who had been conked on the head, I ducked mine, jettisoned the canopy and then with head back, arms on the armrests and feet in the stirrups, I pulled the seat trigger.

"The next thing I knew I was tumbling in the breeze. After that the sensation was one of floating pleasantly through the air. About that time I figured I'd better get the chute open so gave a long pull on the "D" ring. For the first time I felt I'd really had it. The canopy didn't blossom, and I thought I'd been saddled with a blooper! Then I looked down and saw the seat was still with me. The strange part was that the seat seemed weightless — as if it weren't attached to me. As I unfastened the lap belt, the seat seemed to fly off, but I still kicked it away to be sure we separated.

"A sudden jolt — not too bad — and I looked up to see the canopy blossom out. Believe me, after all I'd thought of during the few previous moments — that was mighty beautiful nylon.

"The chute oscillated some, but nothing to worry about. Everything was very quiet on the way down, and the descent was almost fun. The landing wasn't exactly like the best of General Gavin's, but I made a fairly creditable showing and came out of it with nothing more than a bruised knee and elbow."

This pilot committed a serious error which fortunately did not result in injury. He has numerous comrades who have had very similar experiences. In fact, many pilots seem to have a strong urge to pull the ripcord first. This plus the fact that many men do not sense that the seat is still attached to them have caused about 11 per cent of ejectees' pulling the ripcord before opening the lap belt and separating from the seat!

The unfortunate fact is that many of our friend's compatriots have not had as much altitude and thus have had insufficient time to figure out what was wrong, release the seat and get the chute open before ground contact. At low altitudes the hazard of trying to open the chute before releasing the seat is considerable. Another hazard is that of having the chute becoming fouled on the seat after the seat is released. Such fouling has occasionally resulted in very rapid descents and subsequent injury. In one case after the seat caught in the shroud lines it rotated in the breeze, causing the canopy size to become progressively smaller. Had the pilot not had a knife which enabled him to cut the entangled shroud lines and finally release the seat, a successful landing would have been doubtful.

True, there have been a few whose chutes actually opened while they were still strapped in the seat, and three men have landed successfully still strapped in the seat. But you can only push your luck so far!

Of course the automatic lap belt is designed to preclude incidents of this type. When the belt is used with a properly timed (two seconds) automatic parachute, the chances of successful escape from aircraft are greatly enhanced, particularly at low altitudes. Then, too, during ejections below 2000 feet, T. O.'s instruct that when proper body position can be maintained, and the lap belt is not automatic, the belt should be released prior to ejection. Following this procedure would also eliminate the problem of manually releasing the seat at low altitudes.

Unfortunately, until all ejection seats are equipped with automatic lap belts, manual opening of the lap belt will be required during ejection escape. Experience shows that many men either forget to or cannot release the lap belt when ejection occurs below 2000 feet.

Unless training emphasizes unfastening the lap belt before pulling the "D" ring, the figure of 11 per cent who followed the wrong procedure is not likely to lower significantly.

Make a habit of going through your emergency escape procedures frequently, particularly if you fly more than one type aircraft. But don't stop in your training when you've pulled the seat trigger — go ahead and simulate separating the lap belt and subsequent pulling of the parachute "D" ring.

A true story behind one of the lowest successful ejections ever made best illustrates our point. This happened so quickly and the pilot popped out of his plane so low that there was not even a splinter of a second to waste. With swift and perfect sequence he left his seat and deployed his chute. Many congratulated him on his luck. However, the members of his squadron were not in the least surprised by his success. They rather expected it. As his squadron leader explained, "He practiced a lot. More than anyone here, I guess. He always said if he ever had to use the seat he wasn't going to make a mistake." ●

# JET Aural Null

HIGH up on the list in the interesting-statements-we-have-heard department is that of a young jet pilot who commented recently, "The static was so bad that I couldn't tune in the station on my radio compass in either the ANTENNA or COMPASS position. If I hadn't received some steers to another field, and if GCA hadn't picked me up, I would have had to eject."

The truly amazing part of his statement is that the pilot never considered trying the LOOP position to home in using aural null procedures. Although he admitted that he had received instruction in aural null procedures during his training, he stated, "I never gave it a thought. It's too complicated a procedure for a jet aircraft and I don't think I could hack it."

Needless to say, this lad has since been convinced and is spending some time in practice, so that next time he will be able to hack it.

As a result, FLYING SAFETY asked the Pilot's Instrument School (Jet), at Tyndall AFB to prepare an article on aural null procedures, incorporating any special tips or techniques as taught at the school. Here's the word from the boys who know.

### Tuning the Station

Complete knowledge by a pilot of aural null procedures is considered essential since the ANTENNA and COMPASS positions are unreliable when flying in ice-crystal areas, in regions of precipitation static or in the vicinity of thunderstorms. Under any of these conditions the azimuth needle may fluctuate excessively or give erroneous readings, even assuming that signals can be received.

When tuning in for aural null work, select the ANT position, turn up maximum volume and attempt to tune in by ear with the CW-VOICE switch on VOICE. After identifying the station, select the LOOP position and switch to CW. Rotate the loop until the maximum signal is received, re-tune for maximum readability and adjust for proper tone level. If it is not possible to tune in on the ANT position initially because of excessive static or the loss of the phasing antenna, start the tuning process on LOOP and VOICE. Then tune in the desired frequency, adjust volume, rotate the loop for maximum reception, re-tune and identify the station, switch to CW and re-tune for maximum readability and solid tone.

### Orientation and Time

To save time, ambiguity and time-to-the-station should be solved simultaneously. The first step is to take up and maintain a constant slaved-gyro heading. Next, locate the null by rotating the loop until the null is found. Adjust the null width, using volume control, to approximately five to eight degrees. Remember, the width is controlled by adjusting the volume; a volume increase narrows the null, a decrease widens it. Keep in mind however, that if the aircraft is too far from the station, the null will be more than five degrees wide, even though maximum volume is being used.

Next step is to find where the station is in relation to the aircraft and how many minutes out it is. Place the needle on the wingtip position after noting the number of degrees and direction to be turned to place the null on the nearest wingtip position. (If the null is located between 0 and 90 degrees or 180 and 270 degrees the shortest turn to place it on the wingtip is to the left. If it is between 90 and 180 degrees or 270 and 360 degrees the shortest turn is to the right.)

Next, turn to the new slaved-gyro heading computed to place the null on the wingtip. Hold this heading until a 10-degree change in the null position has been noted. Be sure that an accurate time check is made during the 10 degrees of null change. If the null moves to the right, the station is to the right; if it moves to the left, the station is to the left. Once station ambiguity is solved, aircraft orientation must be maintained.

To get time to the station use the formula: time to station equals 60 times number of minutes flown between bearing change over degree of bearing change. For example, if it took one minute to change 10 degrees the formula is set up as $\frac{60 \times 1}{10}$ or six minutes from the station. But if it took only 50 seconds to change 10 degrees, the formula is then set up $\frac{50}{10}$ or five minutes. In jet aircraft, where possible, it is desirable to work at least five minutes from the station because of high speeds and rate of turn.

An important point to remember is that the turn back to the station will be over 100 degrees. Originally, when the null was on the wingtip, the aircraft was 90 degrees from the station; 10 degrees must be added for the bearing change, and at least five more degrees must be added to account for the radius of turn as the aircraft is turned to the station.

At Tyndall, students are taught that as a rule of thumb, if the aircraft is five minutes or more from the station five degrees must be added to the total degree change on the slaved-gyro to return the null to the nose on an inbound heading; 10 degrees added if four minutes out; 15 degrees if three minutes out, and 20 degrees if two minutes out. Thus, to turn to a station that is located to the left and five minutes out, a change of heading to the left of 105 degrees must be made. (90 degrees plus 10 degrees plus 5 degrees.) In a T-33, a fairly accurate distance-from-station can be computed by figuring the speed as six miles per minute. Thus, if the aircraft is five minutes from the station, it is 30 miles out when traveling at about 300 knots.

Home in to the station by keeping the null on 0 degrees and maintaining a constant slaved-gyro heading. If there is no crosswind, a few minor corrections will be sufficient to home on the station. In all cases, remember to control the null width by decreasing volume when inbound.

By maintaining a constant heading a crosswind soon will become apparent when the null moves left or right of 0 degrees. When a null change of two to five degrees is noted, a corrective turn is made in the direction the null has moved, to re-intercept the desired track. (If the null moves to the right, the corrective turn is to the right; if the movement is left, the turn is left.

The turn must be sufficient to return the aircraft to the desired track and *must be greater than the number of degrees of drift.* The extent of this correction depends on the distance from the station, true airspeed, existing crosswind and how quickly it is desired to return to track.

For example, if the aircraft is five degrees off track, 60 miles from the station, it is five miles from the correct position, and a larger angle of interception should be used to return it to the desired track quickly to allow more time for determining drift correction. However, if the aircraft is in closer to the station, say five miles, and the null indicates a five-degree departure from the desired track, the aircraft is less than one-half mile from the desired position; therefore a smaller angle of interception is advisable to prevent overshooting on the correction.

A rapid departure from the desired track indicates a strong crosswind when the aircraft is 60 miles from the station; but this same rate of departure when the aircraft is only 30 miles from the station indicates that the crosswind is about half as strong. After estimating the angle of interception necessary to return to track, use the slaved-gyro as the primary instrument for directional control. When the turn toward the desired track is completed, the null will be on the opposite side of the 0 degree position and can be used to determine whether the correction is large enough to regain the desired inbound track.

When the deflection of the null is the same as the angle of interception, the aircraft is back on the desired track. A turn is then made to the desired heading plus or minus an estimated correction for drift. It will be necessary to lead this turn slightly because of the radius of turn of the aircraft. The amount of lead needed depends on the distance from the station, existing crosswind, the number of degrees to be turned, true airspeed and the rate of turn used. A pilot should use his judgment as to the amount of lead necessary, based on the rate at which the aircraft is returning to track.

After regaining the desired track and making an estimated wind correction, if the null moves back toward the nose, the wind correction is insufficient. In this case a correction is made back to track again and a larger correction is established into the wind. If the null moves away from the nose position, the correction is too large. In this case, a turn is made parallel to the desired track and held until the wind drifts the aircraft back to the desired track. When the null indicates that the aircraft is back on track, a smaller drift correction into the wind is applied.

### Station Passage

There are four methods of determining station passage. One of the best methods, if a proper time check from the station has been made, is to place the needle on a 90-degree position when you are approximately one minute from the station. Hold desired track on the slaved-gyro, after having narrowed the null to three to five degrees by controlling the volume while inbound. Then when station passage occurs, the null will be on the wingtip position.

Another indication of station passage is the constant narrowing and then a definite widening of the null. However, at higher altitudes the null does not narrow rapidly as the station is approached, nor does it widen quickly after passage. Between 20,000 and 40,000 feet it may take as long as three minutes after passage for a definite widening of the null.

Below 20,000 feet, when the aircraft passes directly over the station, the null may disappear and reappear quickly. If this occurs, look for an immediate widening of the null. In static or during a change in heading disappearance of the null is not necessarily indicative of station passage unless the null widens immediately. If the volume is unchanged, null widening indicates that the aircraft is moving away from the station.

A third way to recognize station passage is by a definite movement of the null away from the nose position when the aircraft passes to either side of the station while on a constant heading. It is possible to follow the null completely around to the tail position.

The last method of recognizing station passage is when there is an apparent shift of the null from one side of the nose to another when the aircraft passes close to, but not directly over, the station. In this case the null stays slightly to one side of the nose position and then disappears. If it reappears quickly on the other side, without a change in heading, the station has been passed.

The best indications that a station is being approached are:

- The rapidity with which the volume must be turned down to maintain a constant null width. (Remember, at high altitudes the null doesn't narrow or widen rapidly, and should be monitored constantly.)
- When using a commercial station or Adcock range station, the voice or range signals become audible above the carrier wave, regardless of the altitude of the aircraft.

If interference is so great that station recognition is virtually impossible, turn 30 degrees to the right of the track heading. If the null moves closer to the 0-degree indication, the station has been passed. If it moves away from the 0-degree indication, the station is still ahead.

Penetrations and low approaches using aural null procedures are exactly the same as those used in ADF procedures. Aural-null letdowns are emergency procedures, and should be used when no other method is available. The choice of procedures is left to the pilot's discretion.

One final tip, as taught at Tyndall, might come in handy some day. If the static is so great that it is impossible to get the null aurally, turn the volume on the set full up and then turn the selector switch on the jackbox off of COMPASS. With the station tuned in and the volume on maximum, the minimum needle deflection on the station tuner indicates a 15 to 20-degree null which can be used as a last resort to home in by flying that needle visually, keeping it at minimum deflection position.

Aural-null is excellent emergency insurance. Learning the techniques and practicing the procedures until you are sure you can perform them capably can pay you dividends in the future. ●

# Keep Current

**NEWS AND VIEWS**

**New Magazine Rack**—The people in the Base Flying Safety Office at Tyndall AFB believe in getting the word to the troops. They know that each month the Air Force spends many dollars on publications to give information on new techniques and developments to pilots and maintenance personnel. They also know that for various reasons sometimes these publications don't reach all those who may need them most.

To get maximum dissemination of this material, new magazine racks were built and put up in such strategic places as base ops, Officers' Club, pilots' lounges, all operational sections and in maintenance squadrons.

Actually the racks were designed to fulfill four functions. They have eight holders for magazines, thus assuring that both current and pertinent material is available at all times. On each side of the rack there is space for a poster depicting a current accident prevention program topic. A billboard at the top will point up a significant feature article in one of the publications or can be used for the flying-safety-slogan-of-the-week. At the base of the rack is a mail slot, a pencil and paper for Tyndall personnel to make any suggestions toward improving equipment, facilities or standard procedures.

Novel magazine rack was designed at Tyndall.

The racks are serviced weekly with new material, and action is taken on all suggestions as soon as possible.

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*Blue prints for this magazine rack can be obtained by writing the Base Flying Safety Officer, Tyndall AFB.*

★ ★ ★

**Turbo-Prop Transport** — The first military turbo-prop transport, designated the YC-130, has been unwrapped by the Lockheed Aircraft Corporation and is ready to undergo early phase flight testing at Edwards AFB. As the first transport aircraft initially designed to utilize turboprop power, the YC-130 is expected to fly faster and higher than any existing military transport now in service with the Air Force.

A low-to-the-ground fuselage and a high, upswept tail permits truck-bed loading. The tandem landing gear and sleek nacelles housing four Allison T-56 engines, each rated at 3750 hp, are outstanding configuration features of the aircraft.

The aircraft was designed for a variety of jobs including tactical and logistical support, as well as air evacuation and ambulance plane operations. The hold will contain as much as 20 tons of equipment. It will be used also, for assault and support missions right to the front lines and for carrying troops and materiel for forward airstrip delivery or parachute drop.

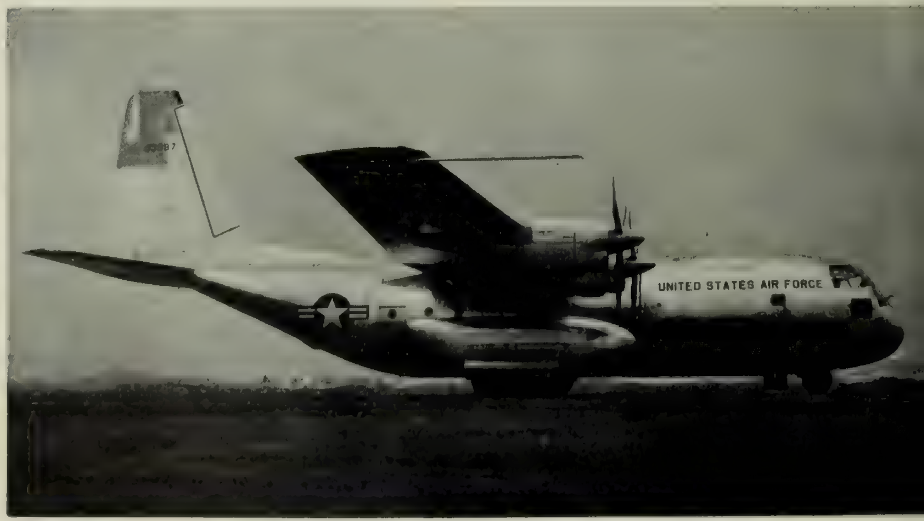
The plane has a wing span of 132 feet, is 95 feet long and 38 feet high. It is pressurized to fly at high altitudes to obtain maximum efficiency of operation.

★ ★ ★

**The New C-123B** — Fairchild flew the first production model of the new USAF C-123B Avitruc assault transport recently in an initial test flight of more than two hours.

The C-123B is a high-wing monoplane in the 200 mph class with a top speed of over 240 miles per hour. It

Four 3750 hp turbo-prop engines power the YC-130. Note upswept tail for rear-end loading.



is powered by two P&W R-2800 engines developing 2500 hp at takeoff and has a range of 850 statute miles with a payload of 16,000 pounds.

With a crew of two the C-123B is capable of airlifting and landing 61 combat troops and their equipment. It also can carry 50 litter patients, six ambulatory or walking patients, five nurses and more than 1300 lbs of equipment needed for medical evacuation missions.

★ ★ ★

**F-89s At Thule**—F-89 all-weather interceptors were assigned to Thule Air Base this August, the U. S. Air Force announced recently.

The first twin-jet fighters already have arrived at the Air Force's northernmost defense post, deep within the Arctic circle.

Move of the F-89s to Thule was effected by a re-assignment of personnel and aircraft of the 74th Fighter-Interceptor Squadron, formerly based at Presque Isle AFB.

★ ★ ★

**New Jet Transport** — Boeing's new jet transport prototype, which made its maiden flight 15 July, already has been flown to altitudes above 42,000 feet and speeds of more than 550 miles per hour.

A total of 15 hours, 46 minutes in the air was logged the first eight days of the intensive test program. On the third flight, tests were conducted at operational altitudes and speeds during which the airplane was climbed to 42,000 feet and flown at speeds above Mach .8.

Longest flight to date was the sixth flight during which the transport remained in the air for just five minutes short of four hours of comprehensive testing.

A company-released progress report on the flight-testing program revealed that it is progressing extremely well and is running ahead of schedule.

To date, the airplane has been climbed at maximum rate to operational altitude, and has been cold-soaked at high altitude to determine that all parts of the aircraft function at low temperatures.

With airbrakes extended on its wings and landing gear down, the plane has descended a mile a minute during tests of fuel tank vents; it has been stalled to test its control and flying characteristics in that condition and it has been banked at various angles to determine the quality of its lateral control at all speeds. A brief check has been made to see if the aircraft could stay in formation with the B-52 as it would during an aerial refueling.

Built in 1947 as an F-80A, this jet made aviation history. Over a period of seven years, it became the first jet trainer, the T-33, and later the first all-weather jet interceptor, the F-94.

The C-123 is designed to operate from hastily prepared, unpaved areas.

The 707 jet transport is shown with the four-segment wing flaps down.

# FROSTY FRONTIER

By Capt. Eldon B. Severson, 64th Air Division (Def)

ON ARCTIC acreage 900 miles from the North Pole, Northeast Air Command airmen have proved once again that the bold art of taming frontiers did not die with the dispatch of the last hostile redskin to the happy hunting ground.

The newly conquered unknown in this case was not polar real estate, but the air masses above it. Aerial pioneers from the 59th and 318th Fighter Interceptor Squadrons working out of Thule Air Base, Greenland, proved for the first time that jet fighter interceptors can operate effectively north of the Arctic Circle.

In the summer of 1952 four F-94Bs took off from Otis AFB, Massachusetts, and pointed their radomes toward Thule Air Base, 2800 miles to the north. This, the first single engine jet migration into the very far north, included refueling stops at Presque Isle, Maine; Goose Bay, Labrador; and Narsarssuak and Sondrestrom, Greenland.

As is true with all firsts, the four aircrews embarked on their historic flight minus valuable information and equipment. No previous jet fighter routes had been established so they had to work out their own flight plan. No Arctic survival kits were available. The Mark IV anti-exposure suits had not yet hit the field. No one knew how jet inflight instruments would react north of both the Arctic Circle and the magnetic North Pole. (Thule lies roughly 600 miles north of the magnetic North Pole.) At that time, there were no air rescue facilities north of Sondrestrom. Locating alternate landing fields was no problem, because there were none north of Goose Bay, Labrador.

The known factors were something less than rosy. The weather along their chosen route can get monumentally lousy on short notice. The open sea in the Davis Strait and Baffin Bay is shocking-cold anytime, and the first mistake in airmanship in the Arctic may well be your last one.

Near the end of the leg from Goose Bay to Bluie West One at Narsarssuak, the flight encountered their first trouble in the form of heavy weather. An SA-16 from BW-1 solved this issue by meeting them 60 miles out and leading them in through the alternate approach in Brede Fjord. This is a dandy little affair in the form of a narrow corridor with solid rock walls over a half mile high. When I asked one wingman what his first impression of the Brede approach was, he replied, "I didn't get one. I was too busy flying formation on that SA-16 driver, who kept warning me against spreading out too far and ramming the large size boulders uncomfortably close to my starboard tiptank."

Detachment #1 of the 59th Squadron touched down at Thule Air Base on September 9th and inked in another page in USAF history books. The first all-weather jet fighter interceptors had reached their new home on top of the world.

From here on out the 64th Air Division (Defense) with its headquarters at Pepperrell AFB, Newfoundland, began calling the signals.

In the nine months that followed, Detachment #1 maintained the most northerly air defense unit on the North American Continent. During this period the 59th Fighter-Interceptor Squadron was transferred to Goose Air Base, Labrador. From there crews rotated to Thule every three months to pull the rugged North Pole patrol.

Operating on a base built upon more than a thousand feet of permafrost and on the doorstep of 867,000 square miles of Greenland Ice Cap is a fine way to separate the men from the boys.

Thule is an instrument manufacturer's nightmare. The magnetic variation there hovers in the neighbor-

hood of 80 degrees. I say hovers because the lines of magnetic variation converge in that area to a point where an aircrew may encounter changes of between 20 to 30 degrees in the process of making a normal airborne intercept. Any lubrication on machine gun parts will freeze them tighter than a miser's purse. For days on end 100 mph winds whip in off the marshmallow hued ice cap to the east, blotting out everything in blowing powdered snow. These big blows are known as "Phase Threes." When one comes along, everyone gets indoors and reacquaints himself with a can opener and C-Rations. No one travels anywhere without padding his frame with pounds of Arctic clothing and felt "bunny boots." In spite of all this, the 59th Fighter Interceptor Squadron chalked up an accident-free record. In nine months of operation, not a single birdman laid an egg with a 59th tag on it. This is fittin' material for the record books, too.

Chapter II of the Thule jet fighter story was written by the 318th Fighter Interceptor Squadron. After a 24-day journey, which entailed 11 hops and 5477 miles, the 318th arrived and took charge in July 1953.

By now the latest in alert hangars, maintenance shops and housing was available. Skilled ground support personnel went to work with the idea that they had the most important jobs in the Air Force — and they did. F-94s and T-33s were airborne around the clock, and those guys on the flight line no one hears enough about were largely responsible for it. The 318th, in the year spent in Santa Claus' backyard, had an average aircraft in-commission rate well above the average for similar type units stationed in the Zone of Interior.

**Left, an F-94 runs up in darkness at noon.**

**Center, mid-day refueling operations at Thule.**

**Below, care of personnel equipment is a must.**

The improvement in base facilities didn't change the operational flying end of the business. The only recovery stations other than Thule Air Base are ice strips at Alert and Eureka. The weird weather is not likely to change in our time. A guy who spends too much time dreaming of little Nell at home instead of aviating every minute, can get in real trouble.

It has been said that Thule is a two-day tour, one day and one night. From November to February aircrews log night time only. The sun just doesn't bother to come up for three months. From late April to August, the reverse is true. It is strictly a daytime operation. You can pick up a pretty fair suntan at three o'clock on a July morning. In spite of the fact that the biggest block of ice in the world surrounds Thule, the humidity there compares with that of the hot, dry Arizona desert.

Much has been said about the paralyzing cold in the Arctic. It is, of course, an ever-present danger. Subzero temperatures, however, are not the climatic factor which has the hardest impact on personnel stationed above the Arctic Circle. The two periods of constant daylight and darkness are the most difficult for a new assignee in the Arctic to accustom himself to. During these periods, the unnatural absence of sunrise and sunset tends to develop what amounts to a weather fixation serious enough to dull the senses. Anyone exposed to this situation will discover that it takes plenty of will power to stay sharp, and sharp you must be in this area where cold-hearted Mother Nature is unforgiving of carelessness.

A short time ago the "Dragons" of the 318th packed up their footlockers after completing a year in the shadow of the Ice Cap. It was a great year for them and for the United States Air Force. They racked up 7313 hours of flying time, made 5261 jet landings and earned the reputation of being one of the best jet fighter interceptor squadrons in the USAF. Part of the credit for this splendid record belongs to sound maintenance practices.

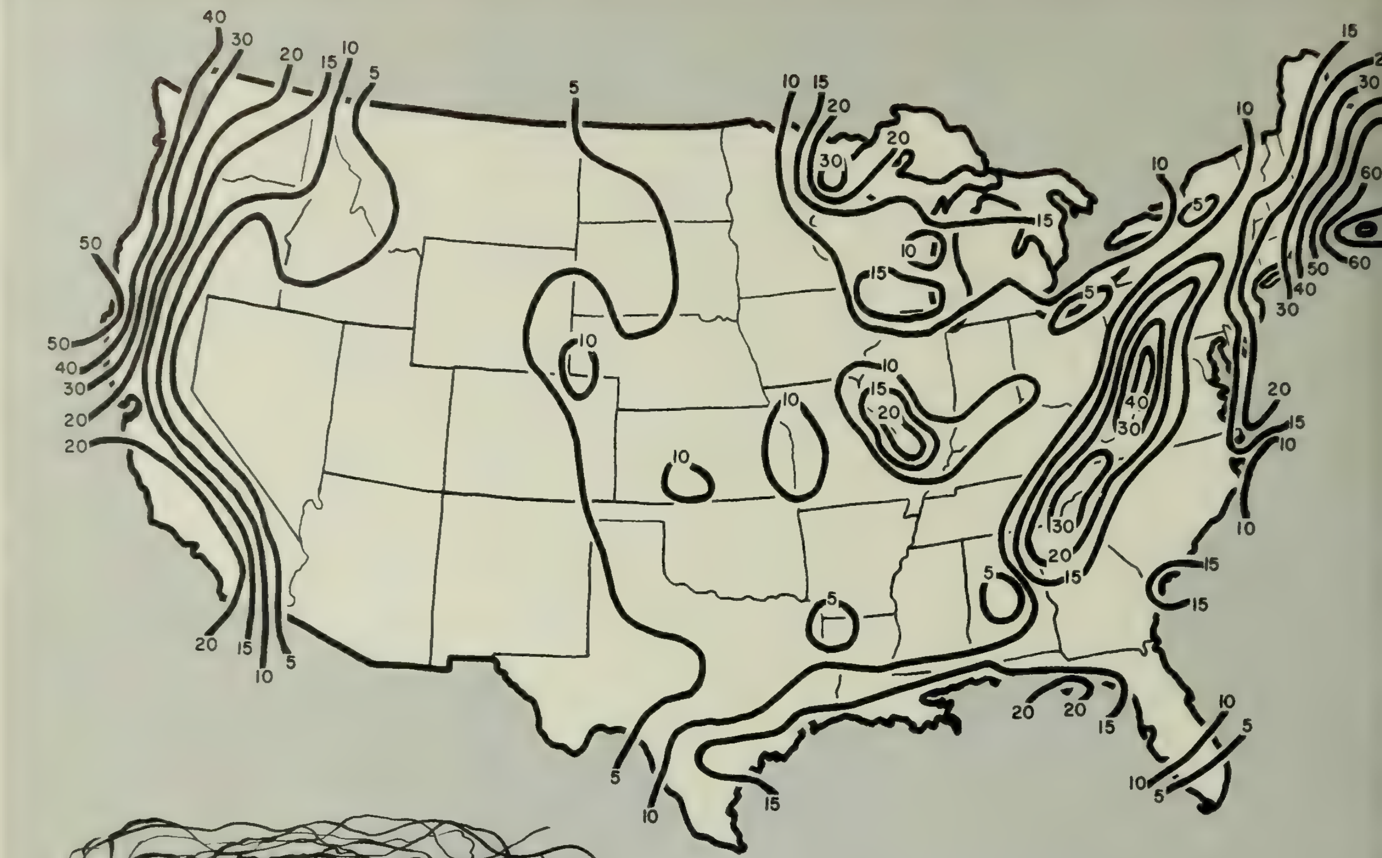
Rated personnel were the targets for 33 pilot proficiency tests. Eight hundred and twenty-five questions were taken from the T-33A and F-94B Pilot Handbooks, AFR 60-16 and the 318th's Standing Operating Procedures. One hard landing marred an otherwise accident free record.

The final tally shows the 318th with a low major accident rate and clean slate in the minor accident column. When one considers that these gents were earning their wages in the toughest territory in the world, with no previous experience in the Arctic to draw on, they did a great job of airplane driving.

The 318th's jet professionals during their Thule tour were also instrumental in establishing the Air Force's coolest gunnery range, over Baffin Bay, 50 miles west of Thule. In conjunction with this, the 318th's Armament Systems Section conducted a comprehensive ground school with major emphasis on cold weather operations. It paid off in accident prevention and the accomplishment of the unit's gunnery training goal. Armament Specialists learned the trick of bore sighting aircraft with the thermometer reading 30° below zero. Smooth teamwork between air and ground personnel made it possible for more than 900 successful gunnery sorties to be flown. The Baffin Bay Range was also the training sight for the Northeast Air Command's entry in the 1954 Air Force Fighter Gunnery and Weapons Meet.

There is no doubt anymore that jet fighters are effective in the Arctic. Hard-helmeted jet jockies in "The Eyes of the North — the 64th" attest to that daily. It is too early to make a sound analysis of the true magnitude of this recent victory over an unknown. However, this we can assume . . . that the work of a few talented Air Force airmen has benefited mankind as a whole. Whether in peace or war, the millions of square miles which make up the polar region north of the Arctic Circle, and which until recent years were considered as a useless wasteland, are a very important part of this globe.

Travel in and out of the far north is best accomplished by air and we are better prepared to traverse this area at jet speed, thanks to the winged pioneers in the 59th and 318th Fighter Interceptor Squadrons. ●



Average annual number of days with fo

# FOG and Low Stratus

By Capt. Gerald M. Breen, Hq, AWS

IN THE words of the English novelist Charles Dickens, fog, wherever it appears, is a "dingy cloud come drooping down, obscuring everything." An airfield souped in by ground fog is not an ideal place to land. Pilots must be especially watchful of this weather element, particularly in the early morning hours.

Fog is really a stratus cloud cover that forms at the ground or so close to it as to affect seriously the surface visibility. It may form either by cooling to the dewpoint temperature or by the addition of water vapor until the dew-point temperature is equal to the actual temperature.

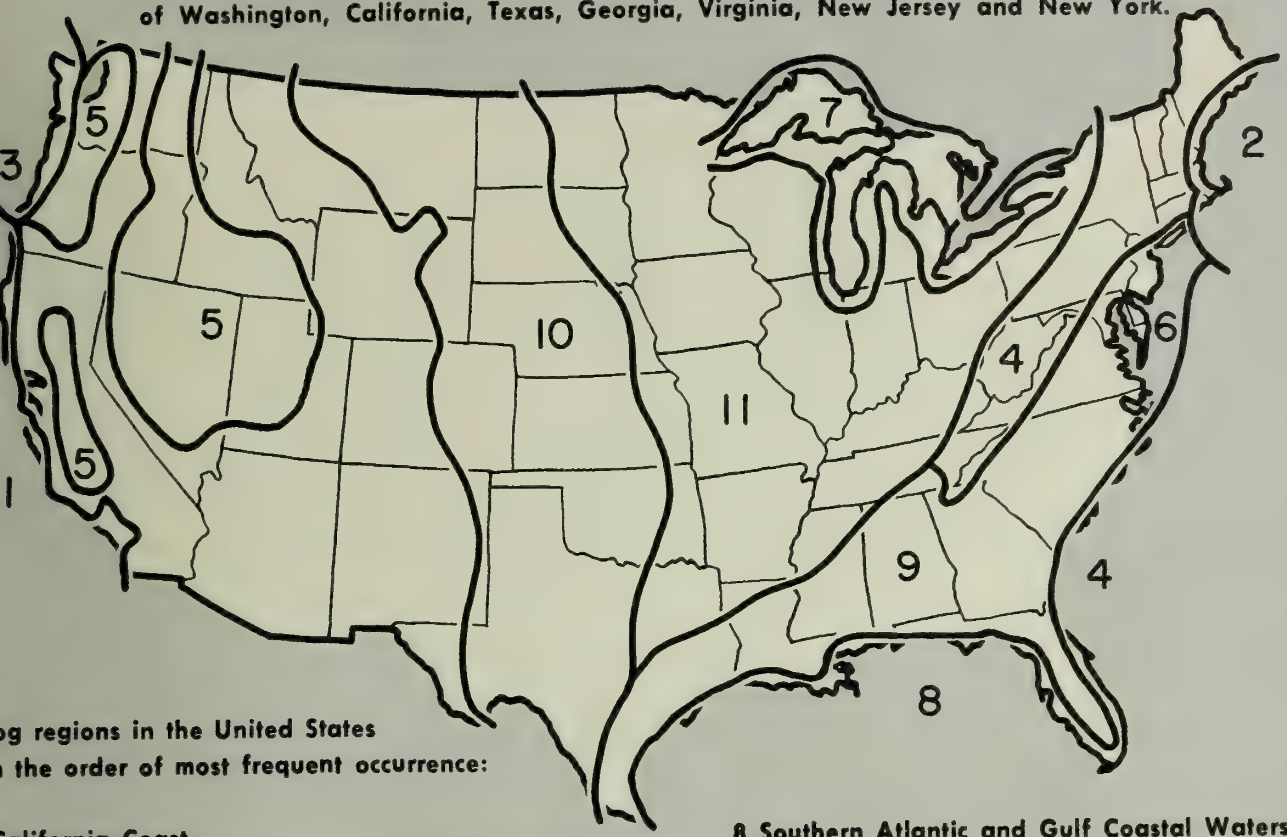
Whatever the cause of the particular fog, its presence means restricted visibilities. Fast-moving planes near the ground have been involved in needless accidents because fog was not considered seriously. An analysis of the aircraft accidents involving fog during the years 1947 through 1953 emphasizes that restricted visibility was a predominant factor in such occurrences as landing on unsuitable terrain, landing short of the runway or running off the end of it, and accidents on GCA approaches.

Of the total aircraft fog accidents during the above period, 54 per cent occurred in California, Washington, Texas, Georgia, Virginia, New Jersey and New York. These states are situated in regions of most frequent fog occurrence, as seen by reference to the accompanying maps.

The maximum of fog frequency does not occur necessarily in winter at all land stations nor in summer at all maritime stations. The formation of fog, especially over land, depends very much on local peculiarities, which may bring about great changes in the fog frequency over small areas.

Low stratus clouds are formed by the same surface contact cooling and radiational cooling of the lower atmosphere that produce fog. The lift-

**Highest frequency (54%) of aircraft accidents involving fog occur in the states of Washington, California, Texas, Georgia, Virginia, New Jersey and New York.**



**g regions in the United States**
**the order of most frequent occurrence:**

**alifornia Coast**
**ew England Outer Coast**
**orthern Pacific Coast Line**
**ppalachian Valleys**
**5. Pacific Coast Valleys**
**6. Middle Atlantic Coast**
**7. Great Lakes**
**8. Southern Atlantic and Gulf Coastal Waters**
**9. Gulf and Atlantic Coastal Plain and Piedmont**
**10. Great Plains**
**11. Ohio, Missouri and Upper Mississippi Valleys**

ing of fog either by solar heating of the ground or by wind turbulence produces a low stratus as its first effect. The formation of low stratus is particularly favored by direct radiational cooling from the top of a layer of moist air in the absence of higher cloud cover.

Along the coast line of Southern California, shallow, low-lying stratus clouds, called high fog, are an extensive type of nighttime and early morning cloudiness. Because of the varied elevation of the land, cities near the Pacific Ocean may have a low overcast of stratus clouds, while the crests of the hills are socked-in by the high fog. On the other hand, the cities may be smothered in fog, while the hilltops are in the sun. When the stratus clouds settle to the ground, flying conditions around Los Angeles become difficult. Planes are forced to land farther away from the coast line. Fortunately, nature has compensated somewhat by providing areas that are relatively free of fog and still located close to the metropolitan district.

Sea fog occurs from the cooling of sea air over a cold ocean current. It often has its best development near land; for example, on the coast of California, where sea air passes over the cold California current producing persistent summer fogs.

The land and sea-breeze fog is of frequent occurrence in summer along the eastern coast of New England. Its formation comes with light westerly winds. The westerly current is warm, and the cooling over the sea quickly produces condensation which, in the slight movement prevailing, must take place at the surface. Under these conditions afternoon sea breezes are likely, and the fog is brought inland.

Land and sea-breeze fogs are, by their very nature, coastal phenomena. They occur only on those coasts having light land breezes in warm, moist air and therefore only on eastern coasts of continents. These fogs occur in summer only, particularly in early summer when the oceans are still cold. They can occur also over large inland bodies of water such as the Great Lakes.

Almost all fogs occurring over the land are caused basically by radiation cooling of the lower moist air. Ground fog, the simplest example of a radiation type, is a shallow but usually fairly dense fog through which sky or stars are directly visible overhead. It is formed as the result of a single night of radiation cooling. Radiation fogs have their maximum occurrence at the time of year when there is a considerable amount of water vapor present and the air is cooled by nocturnal radiation. In the Ohio, Missouri, Upper Mississippi and Appalachian valleys, this type of fog occurs from September through autumn to December.

Another type of radiation fog is that termed high-inversion. High-inversion fog is essentially a winter phenomenon and, like all radiation fogs, occurs only over the land. It is the result of long-period cooling, characteristic of continents outside the tropics in winter. Superimposed on this, of course, are the radiation effects of each night. Often the high-inversion type may become high fog, or low stratus cloud, during the day, changing to a dense fog at night.

The best example of the high-inversion type of radiation fog in the United States is supplied by the winter fog in the low valleys of the Pacific Coast. High-inversion fogs are the most persistent and tenacious to be found anywhere in the United States. This type of fog often continues without interruption for several days at a time.

Tropical-air fog differs from sea fog in that it depends simply on the gradual cooling of air as it moves from low latitudes poleward over the ocean, and not on the cooling by passage over a cold current. In wintertime, "pea soup" fog occurs when maritime tropical air is circulated northward from the warm Gulf of Mexico. As the air travels from the south, it is cooled to saturation in its lowest 1000 feet by contact with frozen ground or colder water over which it passes. Regions of greatest "pea soup" fog frequency are the Middle Atlantic Coast in April and the Southern Atlantic and Gulf coastal waters in January and February.

Steam fog occurs over rivers, often when the air has been cooled by radiation, and tends to form radiation fog near the river as well as steam fog on the river. In general, steam fog is quite shallow, extending into the air 50 to 100 feet, but deep enough to interfere with takeoff and landing. Over the Great Lakes the principal occurrence of steam fog is in midwinter when the cold continental air passes over the lake waters, which have a temperature slightly above freezing. In the spring and early summer, when the atmosphere is rapidly becoming warmer, the lake waters retain much of their winter chill; and in autumn, when the first cold-air outbreaks come down from the north, the lakes still have the warmth of summer.

Advection-radiation fog forms by nighttime radiational cooling in air that has come inland from the sea during the day. Air of high humidity coming from a warm water surface is cooled by radiation during the night. This fog occurs mainly in the late summer and autumn in the Gulf and Atlantic coastal plain regions and the Piedmont area.

In regions where the land slopes gradually upward, such as on the Great Plains of the United States and Canada, fogs sometime form as a result of the cooling of the air (by an expansion during which no heat enters or leaves) as it moves to the higher elevation. The surprising feature of upslope fogs is that they can develop and maintain themselves in strong winds. The more rapidly the air moves up the slope, the faster will be the cooling process. Upslope fogs prevail chiefly during the months of April and September.

There is little difference between warm and cold front fog as each is formed from moisture of falling precipitation. However, since the precipitation band associated with a cold front is much more restricted in area than that of a warm front, the post-cold-front fogs are less widespread.

In fact, it is only a cold front which has become quasi-stationary, that has an extensive fog area associated with it. In the stable continental polar air masses of the midwestern United States stratus or fog forms for some distance behind almost all cold fronts that have produced moisture in the form of general precipitation.

Prewarm-frontal fogs offer the greatest obstacle to operation of scheduled flying during winter months in the southern and eastern United States. When stable continental polar air of winter is overrun by precipitating warm air masses, fogs or very low stratus form. The distribution of fog in the Ohio, Missouri and Upper Mississippi valleys is dependent on the effects of air drainage, proximity of rivers and other water bodies, city smoke and industrial areas.

When fog is mixed with smoke and other air contaminants, the result is a thick, sooty cloud called smog. Heavy smogs frequent smoke-filled industrial areas when weather favorable for fog lasts over a period of several days.

Regardless of the area or type, fog spells restricted visibility and trouble. Your destination may be clear as a bell when you take off, but if fog is a possibility, be ready. Your best friend in such a case still will be a good alternate. ●

| FOG REGION | MAXIMUM FOG OCCURRENCE | KIND OF FOG |
|---|---|---|
| California Coast | July, August | Sea (air mass, advection) |
| New England Outer Coast | June | Land and sea breeze, (air mass, advection) |
| Northern Pacific Coast Line | July, August | Sea (air mass, advection) |
| Appalachian Valleys | September | Ground (radiation) |
| Pacific Coast Valleys | October thru January | Radiation (high inversion) |
| Middle Atlantic Coast | April | Sea and tropical air (air mass, advection) |
| Great Lakes | May, October | Land and sea breeze (air mass, advection), steam fog; advection-radiation |
| Southern Atlantic and Gulf Coastal Waters | January, February | Sea and tropical air (air mass, advection) |
| Gulf and Atlantic Coastal Plain and Piedmont | September, October | Advection-radiation |
| Great Plains | April, September | Upslope (adiabatic expansion), post-frontal (cold front) |
| Ohio, Missouri and Upper Mississippi Valleys | September thru December | Ground (radiation), prefrontal (warm front) |

# *make this a Merry Christmas*

Once more we are on the threshold of a holiday season and thousands of service personnel will be going home for a few days with their loved ones.

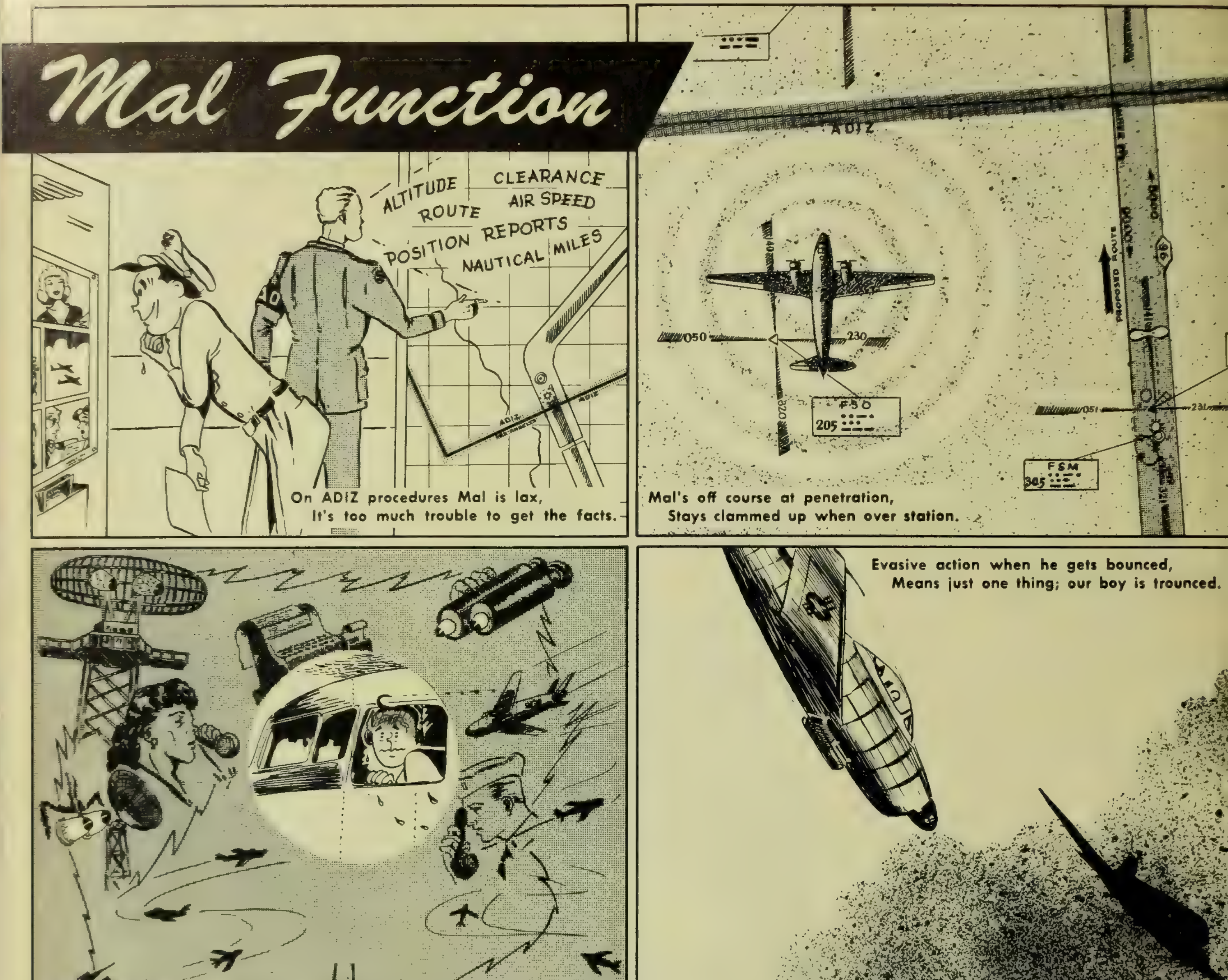
You, as an Air Force pilot, have a tremendous responsibility whenever you fly, whatever the season. But during the coming holidays, when you are likely to be transporting many service people, stop and think before you leap. Don't spoil the festive season by a touch of "get-home-itis."

Although AFR 60-1 prohibits flights solely for the convenience of individuals or groups, you must remember that thousands of flights will be scheduled for military purposes. Some space will be available for the Christmas hitch-hikers. After a flight is scheduled, consider well your responsibility both to your passengers and to yourself.

**Plan your flight. Fly your plan.**

**Make this a Merry Christmas for all.**

# Mal Function


ALTITUDE
CLEARANCE
ROUTE
AIR SPEED
POSITION REPORTS
NAUTICAL MILES
ADIZ
On ADIZ procedures Mal is lax,
It's too much trouble to get the facts.
ADIZ
050
230
FSO
205
FSM
305
PROPOSED ROUTE
Mal's off course at penetration,
Stays clammed up when over station.
Evasive action when he gets bounced,
Means just one thing; our boy is trounced.
Mal's mistakes set things in motion,
The likes of which, he has no notion.
No explanation for holes in plane,
Mal's last trip is made by train.

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DECEMBER 1954

# FLYING SAFETY

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## ANNUAL JET ISSUE—Part One

# FLYING SAFETY

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The cover is our holiday greeting to you, our readers. The staff of *Flying Safety* extends best wishes to all for the coming New Year.

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## SUBSCRIPTIONS

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USAF PERIODICAL 62-1

**Experts Discuss**

# POWER APPROACHES

*In the not-too-distant past, many tigers had their whiskers bristling over what they called "this Gooney-bird pattern routine." They wouldn't buy a procedure that called for maintaining power-on in the pattern, that eliminated a steeply wracked-up break or one that had any semblance of a down-wind leg.*

*Sure, they flew World War II fighters that way . . . no sweat. Many of these growling tigers got away with it in jets, too, for a while. Some didn't.*

*In the files of the Directorate of Flight Safety Research there is case after case of those who didn't. And in many of them, weather and low fuel aren't even factors. Fortunately, such instances are the exception rather than the rule but when we dig back into the history of a pilot who is unfortunate enough to clobber an airplane, we invariably find an inherent weakness that came about as a result of early carelessness which was allowed to become a habit.*

*From the time a pilot starts his initial pitch-out, until the landing is safely effected, the entire pattern determines whether or not the maneuver will be successful.*

*Last March, FLYING SAFETY asked several of the top test pilots in the business to give us their views on power-on approaches in jet aircraft. The ensuing article was so well received by the field that we decided to reprint it in our all-jet issue.*

*This stuff isn't new. It's all in your Dash-Ones. However, our records show that a very small minority apparently have missed the chapter on "how to fly the airplane."*

*There follows a series of discussions by experienced men who really KNOW their business. If you'll take it to heart, be you a good steady pilot or a sizzling stone, we think it will pay dividends . . . to you!*

---

### *Tony LeVier, Lockheed Aircraft Corp.*

---

IN DISCUSSING this business of approaches and landings in an airplane, I feel that this combination is one of the most difficult to accomplish. By that I mean, the most difficult maneuvers to accomplish consistently. From the time a man takes the first flying lesson until he actually soloes, approaches and landings seem to take up the major portion of instruction time.

You spend hours grinding around the circuit only to get back to that situation where a landing is inevitable. Maybe it is easy for some people. I don't know. For me it was plain hard work to learn. I had to develop judgment in speed and altitude and finally, depth perception. Sure, you learned a bit of everything else, too, but mostly it was up and down, up and down. Bounce. Gun it. Take it around. Down again.

In my book, a landing draws more comments from onlookers and passengers than any other maneuver you might make. You bounce a little bit and immediately get comments from every witness in the area. Make a nice smooth one, grease it in, and nobody says a word. *You* may comment about an especially smooth one, but such remarks fall on deaf ears!

I remember when I first started flying. My instructor was very fussy about approaches. When I got the airplane on a base leg, things had to be right. I had to put it in a certain position, have a certain altitude, maintain a certain attitude, keep my power right where he wanted it and above all, fly the airplane. He wouldn't tolerate any sloppy attempts. It was darn good training, too. I've never forgotten his lessons.

Of course we didn't have drag flaps and things like that in those days. The landing gear was welded down too. But, those early planes were light. They'd glide a long ways and you really had to chop the power back and slow 'em down to get in. Slips and fishtailing aided a lot too, but that sort of thing was confined to the old OX-5s, Eaglerock and Waco class, certainly not F-94s.

Well, we've progressed a lot in the last 20-odd years. We've seen airplanes get faster and faster and at the same time, a whale of a lot heavier. They're certainly fast today, but the airplanes of the future, those for the Air Force and the rest of the military, will have performance bordering on the missile. Of course a true missile is a pilotless projectile but as long as we still have pilots flying airplanes, we'll continue to improve performance. Stuff in the 2000 mph class will probably show up in the not-too-distant future, and pilots will be flying them too.

In spite of this thinking, we've got to consider the fact that airplanes will still have to operate in the 150 and 200-knot category insofar as takeoffs and landings are concerned. No matter how fast a plane may fly at maximum performance, we'll still have to plan to bring it down at reasonable speeds. We can say that 200 or so is an average figure, but that's still smoking right along. So, even at that comparatively low speed, we've got to have a definite pattern and approach to insure safe operation. Okay, let's discuss those factors that make up safe operation. These will be just as applicable to T-33s as stuff in the 100 series.

I believe the easiest way to define satisfactory approach and landing procedures is to diagram the whole thing. I've sketched out what I call the "ideal pattern." Probably there are many who will disagree with me, but it's the way I feel about it. After twenty-odd years of flying everything from Jennies to F-94s, I still use the tried and true approach and landing technique that was taught way back when . . . and . . . I'm still here to discuss this technique.

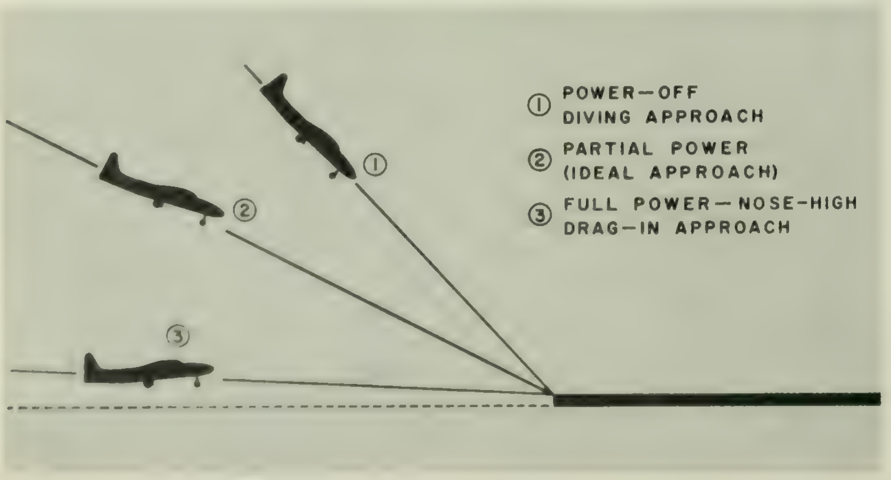
Let's take a typical approach. I've been out on a mission or a training flight or maybe a shakedown. It doesn't matter. When I get home, fuel is down to critical limits. I can't fool around with more than one approach and so I plan everything carefully *before* I drop off all of my altitude.

My system has always evolved around the theory that it's easier to put an airplane where I want it by using a modified approach, than any other. By that I mean it's a compromise between the true, power-off approach and the long drag-in with everything open but the windows. One reason particularly governs my thinking along these lines. As speed and weight of aircraft continue this upward spiral, it will become increasingly necessary to use power for a safe approach. Sooner or later, power will be a *must* to complete a safe approach and landing. Therefore, while still on the borderline of such equipment, why not learn the logical technique until it becomes second nature? It's the cheapest kind of insurance, believe me.

Now, let's take a typical pattern and landing in . . . well, let's say a T-33. Maybe you're just going through school. On the other hand maybe you've got several thousand hours under your belt, but it's all conventional stuff. Okay, whether you're a student or an old hand, you still want to learn to fly this machine right.

For the sake of discussion we'll assume that you have a thorough working knowledge of the airplane. The actual mechanics of flying are things already mastered and the art of a good landing is an assured fact. But, we still have one problem to overcome. How do we *consistently* bring the plane into traffic, establish a good pattern and then put the buggy on the ground *exactly* where we want to? I don't mean a good one now and again. I mean good approaches and landings all the time.

Here is Tony LeVier's sketch of types of approaches. His ideal pattern calls for partial power.


①
②
③
① POWER—OFF DIVING APPROACH
② PARTIAL POWER (IDEAL APPROACH)
③ FULL POWER—NOSE-HIGH DRAG—IN APPROACH

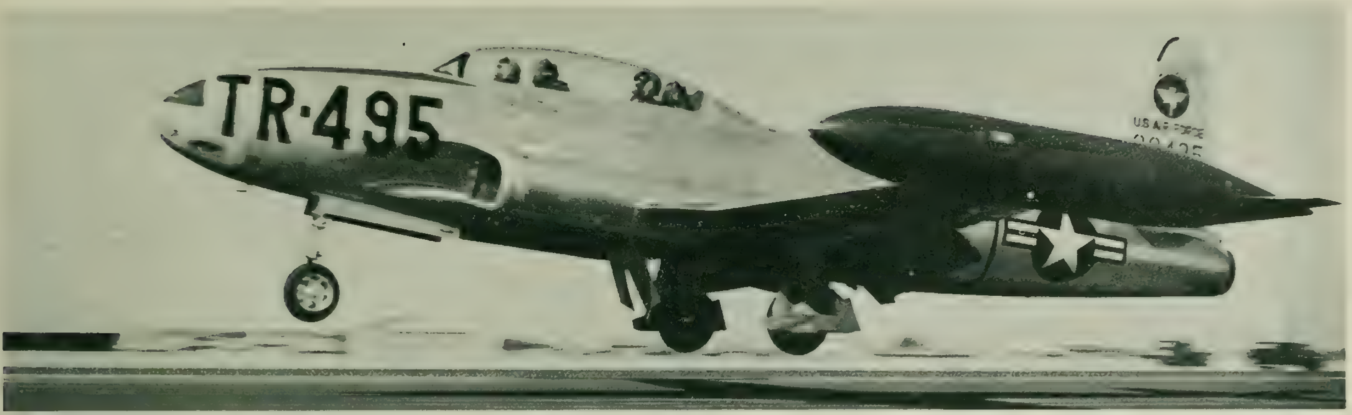
This T-33 isn't the hottest piece of machinery going today, but it is the transition airplane you'll be exposed to for some time to come. It's clean and fast and comfortable. You won't have any trouble with this bird upstairs, or downstairs either for that matter. It gives you good control in all speed ranges and doesn't have any nasty habits.

Okay, so you're coming down for a landing. What's the first procedure? Plan your pattern. I mean PLAN it. You've got a breeze of about 15 knots on the deck and it's almost down the runway. There's no real problem here except to establish a good pattern and follow through.

On the upwind leg, over the runway, you've already lowered the dive flaps and knocked the airspeed down to 175 or maybe 200. About a third or possibly half way up the runway you roll into the break. This doesn't have to be violent. Just make a nicely coordinated turn and keep it going for 180 degrees. If you happen to be of the "two 90-degree turn school," that's okay too. No matter how you do it, make certain that you get the airplane on a definite downwind leg and then take off most of the power and get the gear and flaps down. Keep the altitude a constant factor and let the speed fall off normally. Above all, don't wrack around through the early part of this maneuver like a mad-man. Sure, I know you may be hot. Possibly you even sizzle a little bit. That's swell. Save that stuff until you're upstairs. Down here in traffic, play it easy. You're not going to impress anyone with screaming tactics down here near the ground.

Once you're on a definite downwind and the gear and flaps have been extended, run that power up to at least 60 per cent. Remember, acceleration time from 60 per cent to 100 is darned fast. Acceleration from idle to 100 per cent is darned slow. That's the most important thing to remember. Keep that mill turning in the upper speed ranges and you'll stay out of trouble.

The rest of the pattern is pretty



"... hold things constant until you are assured of making the runway, then, as you start to ease back on the stick, start to ease back on the power."

much standard. Make a definite base leg and turn on final with ample speed. By that I mean, keep the airplane well above the stall range. That doesn't mean that you should bring the plane in like a bat out of you-know-where, but do keep a reasonable head of steam on. Fly it at 130-140 knots, somewhere in that area. Keep enough power on to steady the airplane all the way down. A good approach is one that compromises between a diving glide with no power and a long, nose-high, power-on drag for the runway.

Here's something else to remember, too. You who have been flying conventional aircraft are generally used to having the nose of the airplane pretty much follow the actual flight path. In the jet however, you'll find that the relation of the horizontal axis of the plane to the actual flight path varies considerably to that which you expect. For example, in a true power-off glide, the nose will be tucked down at an alarming angle. The rate of sink will curl your hair and you'll be quite concerned as to where to start breaking the glide for round-out.

In the full throttle type of approach, gear down, flaps down, speed brakes open and throttle at or near 100 per cent, the nose will be high. You'll feel as though you're hanging on the ragged edge of nothing. It just isn't comfortable. Bear in mind, I do not imply that this sort of approach is dangerous. I certainly do not. In fact, there may come a time when you'll *have* to drag one in, but, in this discussion we're kicking around the subject of normal approaches.

Okay, now for the normal, partial-power approach. With the throttle set at between 60 and 70 per cent you'll find that the plane is extremely stable. The nose of the ship appears to be following the actual glide path and the rate of sink is minimized. Control is good and the airspeed is within tolerance. You have the feeling that you're flying the airplane correctly. Know why? Because brother, you are. That's the way the plane should be brought in. I think my diagram explains this type of approach clearly.

Right here I'd like to inject some positive thinking about glides. Every airplane has a definite *glide factor*. By that I mean a factor that remains constant. You should take this into consideration each time you set up a pattern.

Suppose, for example, the stalling speed of your airplane is 100 mph and factory tests have established a glide factor of 1:35. Here's what you do. Multiply the stall speed by the glide factor and you come up with the ideal approach speed. In this case, it would be 100 x 1:35 or 135 mph. Then, should you lose an engine or find it necessary to make a power-off approach, you'd still have the correct speed to assure a safe round-out and touchdown.

Every pilot should be familiar with the glide factor for the particular airplane he's flying.

Now it's just a case of holding power, speed and attitude right on down to the deck. Hold it until you've got it made. By that I mean, hold things constant until you are assured of making the runway, then, as you start to ease back on the stick, ease back on the power. Learn to coordinate this action and you'll never go wrong.

About the only other thing I'd like to mention is the effect of wind. I don't care whether you're flying a Cub or the latest blow-torch, you've still got to consider the breeze when you're ready to set down. Of course a strong wind has compensating factors. It automatically stretches the runway, but you've got to allow for it in any plane.

Let's say for example that you're coming in with a stiff breeze right on the nose. You may get the impression that the plane is stalling because you're not making normal progress in relation to the ground. The rate of sink appears to be excessive and finally you start jamming on more power. That's okay, up to a point. It's best to be a bit on the high side in a heavy wind, especially if it's gusty, but too much power can mean too much speed and then you're laying yourself wide open for a galloping or porpoising ride down the runway when you try to get stopped. So you say, "Well, what is safe?"

Here's a good rule of thumb: *Take the known wind velocity and add 50 percent of that factor to your approach speed.* If the surface wind is 50 knots, add 25 knots to your approach speed. This will take care of any sudden changes, such as gusts above or below the average velocity.

Use flaps and power as needed. Stay a few jumps ahead of the airplane, and stay loose. I mean it. Make yourself be relaxed and anticipate the little buggy. After all, it's a mechanical thing at best. You are human.

That's about all I have to offer on this subject. Learn to fly your airplane right and it will take care of you. Don't ever run out of altitude and brains at the same time. Use that old throttle to get you down just the same as you use it to get upstairs. It's a two-way proposition.

*J. J. Quinn, Northrop Aircraft, Inc.*

WE HAVE long been advocates of the power-on approach, particularly since flying the F-89. In it we have a fast and heavy airplane; it weighs plenty and is just a great big piece of equipment. In spite of its size and weight, it's a darn good flying airplane. However, what I try to pass along to every squadron is just this: learn to make each and every approach the easy way.

Let's look over what I consider to be a normal pattern. You make a nice easy break and slow the plane down to around 200 knots. Maybe I should say that the other way. Slow her down as you come up the active runway and then make the break. In any event, remember, you're going to do either two 90-degree turns, or one big 180. Either way you prefer is okay but this is important; you should plan for and make a definite downwind leg in order to get oriented and plan the rest of the approach.

Okay, let's say that we're down to about 200 knots in the '89 and on a definite downwind leg. Right here we dump the gear and set the speed brakes the way we want them. Of course the Scorpion is a bit different than many fighters in that we can visually check the position of the gear. You can see the main wheels and then feel the nosegear when it chunks into place. On top of that we have the visual indicators for a further check, plus the hydraulic gages. When the pressure comes back up and all indications are normal, I know I've got wheels under me. That's important.

I advocate carrying 80 per cent power in the F-89 all the way round. This has the advantage of giving steady performance; it gives you the feel of your plane. I realize that when I speak in terms of 80 per cent power, this must of necessity apply to the '89 only because on this aircraft we've got the deceleron system to aid us. I'll speak of that a bit later.

As you come in on final, you slow the airplane down to between 140 and 150 knots but you have power on all of the time. Of course you have the speed brakes out and the landing flaps down too. With this sort of airbrake system working you can establish almost any rate of descent you want. Remember, with full flaps you're getting a lot of drag but have complete control of the airplane.

If there is any question in your mind about landing you can continue the approach with takeoff flaps at 30 degrees and 85 per cent speed brakes to slow you correctly. As I've said, there are any number of combinations that you can establish to derive the maximum benefit from the braking system. Your internal and external load will have a lot of bearing on the braking configuration you'll need. And this isn't the time to try to discuss each and every landing condition. The Pilot's Handbook will clarify such situations which *must* be planned for in advance.

One point I want to make clear, however. If you'll plan your approach for about 140 knots and power at 80 per cent, you'll have almost enough push to keep on going if necessary to make a go-around, and believe me, you won't have to sweat out any thrust lag if you really need some additional power.

If you learn this technique of the power-on approach at the very beginning of your training, I can't see how you'd ever lose a thing by it. Some people still talk in terms of losing an engine while in the pattern. Well, of course, it *could* happen, but the chances are almost nil. If that

J. J. Quinn has long been an advocate of the power-on approach. "Keep some power on all the way around to the deck. That's doing it the easy way."

power plant functions normally throughout a mission, and you don't manage to run yourself out of fuel, I can't believe that the engine or engines will fail just because you're over the home base. It just doesn't make sense. So—let's depend on that available power, and use it.

Remember this too. If a pattern is learned well, it will take care of the pilot. If he gets into the habit of making his pattern the easy way, and in what I feel is the safe way, then everything will be all right. You've got to bear in mind that some days a guy will be real sharp. On others maybe he won't be so sharp—well, if he has the habit of flying right—the easy and safe way—it won't matter too much. He'll still make it okay.

Actually there isn't much more to it. You learn to set up a good pattern. You practice until it's second nature. Then all you've got to remember is to sustain the power of the airplane for the rate of descent you want. Certainly you won't be pulling enough power to fly the airplane level, and you don't want complete power off. You just want an easy rate of descent once the plane is on final. I can't say definitely how many feet per minute you'll want but you'll figure that out for yourself. You don't want the plane hanging on the ragged edge of a stall, nor do you want to be pouring black smoke out all over the place. Just hold enough power for a really easy descent.

In my own flying, I keep a little power on all the way to the deck, or just before the touchdown. I pull off the power when I have it made. That, to me means when I'm over the runway numbers. This may be a bit too conservative for some of the younger pilots but I think it is right, and that goes for any airplane. As far as I'm concerned, power means control. As long as I've got control, I'm not going to bust up any airplane.

Previously, I mentioned the deceleron system. That means merely split ailerons. These give you drag only, no lift at all. The system is controlled by a handle that operates over a full range. We call it the third throttle. You can pre-select any amount of drag for the landing approach and have any amount of speed that you want. I guess that's about the only difference between the '89 and other jet fighter aircraft.

In summation I feel that the whole business of patterns and approaches can be boiled to just a sentence. Plan your pattern, fly the plan, use the power you need and set the bird down where you planned. It's that simple.

## *Rusty Roth, Republic Aviation Corp.*

AS FAR as I'm concerned, good traffic patterns and power-approaches are completely synonymous. The two tie together right straight through.

There's one thing about using that engine that too many pilots overlook. I'm speaking now of present-day equipment. If that power plant is going to function for an entire mission, it's a good bet it's going to run for the entire landing pattern.

Originally, when we first started flying fighters, they used to load up like mad after the power was closed off. Naturally you always assumed the worst situation when planning the approach and made a pattern that would insure getting in even if the mill quit. If it suddenly became necessary to get some power out of the engine, especially the in-lines, it was strictly nip and tuck. If the power plant was loaded up, well, maybe you got some push in time, maybe not.

In any jet engine that I know of, you already have that worst condition if you pull it back to idle. It's automatic and I don't mean it loads up either. It's just that it's going to take time to get that power back on. You've got a built-in lag, starting from idle, that can get real deadly unless you play your cards right. How do you draw a good hand? Well, let's analyze the situation.

First, we have to remember that in a jet airplane the reliability of the engine at partial power is much better than with the throttle in idle. Right there is the first good card to play. Why select a power setting that automatically puts you behind the well-known 8-ball?

Next, and this is mighty important, you're going to draw that second card on the break. Your speed has got to be right for the particular airplane you're flying and you've got to fly it around cleanly and smoothly. Once that break is made, you've established a great many things to come.

At this point I advocate pulling the power back until the horn blows. You've got to kill off some speed anyway. Get that warning horn blowing while you're rolling around from peeloff to downwind, then, as your speed falls off, you dump the gear. One advantage here is that when the racket stops, you know that the gear is ready for business. Of course you check the indicators too, for there's no use in getting careless at this point.

After you've checked the gear, you've got adequate time to start easing on power again. I usually use between 60 and 70 per cent. The amount of power you put back on is again dependent upon the speed at which you initially broke—how far out you had to go to slow down and so forth.

Once you have the power that you feel is necessary, hold it as a constant factor and plan the rest of the pattern. Keep everything right in the groove and work your way around to final approach.

Now here's another card for that pat hand you're working up for yourself. As you come around on final, you can start to ease off slowly on the power. Normally you'll find that the power you used on downwind and base is a bit excessive for final approach. After you've got the runway lined up correctly you'll be continually bleeding off all the way in, until you finally reach the idle stop. Of course you're still carrying power all the way down to the deck because of the inherent lag in jet engine deceleration. What that boils down to is this: As in acceleration time to get thrust in a jet engine, it also requires a little time to lose that thrust once you chop it. With practice you can anticipate ahead of time and chop it a little sooner than you normally would in a conventional engine.

Now here's still another card you'd better be holding: Keep this in mind and you'll be increasing your longevity by the numbers. The biggest difference between the old World War II fighters and the airplanes we're flying now is the gross weight. The old tonnage has gone up tremendously, and consequently when you put the gear and flaps down and haul that power off, your rate of descent from gross weight alone, is almost double that which it used to be. And in order to make a round-out at a terrific rate of sink, you need a great amount of airspeed.

If you're planning to flatten out that glide on final approach, there are two ways to do it—you can keep the airspeed well above stalling so that your flare is short of the end of the runway and then coast up to it or you can use a reasonable amount of power and maintain a nice shallow rate of descent and thereby eliminate that sharp corner where it's necessary to get the nose up—but fast!

Getting back to the pattern business for just a moment, I find that if I play a pattern right, again comparing it with the old propeller driven airplane, I'll put my gear and flaps down on downwind. Then I regulate my power for desired rate of descent all the way in to the end of the runway. With a properly executed pattern I never worry about losing an engine. Incidentally, in several thousand landings with jet aircraft I've never lost an engine. In any event, if that ever happens, I know that I can suck up my flaps to compensate for the power loss and still make it.

Here's one more card for that pat hand you're trying to build. Draw this one and you'll be holding a royal all the way through: Accident reports show that even on short runways where individuals set up an undershoot pattern, they sometimes hit the jackpot and overshoot. Why? Well, let's look at it this way. Take a theoretical case of a pilot trying to crowd a modern fighter onto a short strip. He sets up a landing pattern and is trying to slap the wheels right on the end of the runway. Okay, everything is going along pretty good until he suddenly realizes that his pattern is leading to an undershoot. At this point he's in real trouble. He's waited too long to correct the situation but goes ahead and slams in full bore anyway. Unfortunately this hypothetical soul is just about three steps behind the airplane and by the time he feels that he's got it made, it's too late.

He's neglected to take deceleration time into consideration and even with the throttle in idle, the old mill is still delivering push. End result? Chalk up another overshoot. In other words, you've got to lead a jet airplane all of the time. You can only get the know-how from experience. So—play it cool and get sharp. ●

**"I regulate my power for desired rate of descent all the way to the end of the runway. The main thing is, keep power on until you have it made."**

# Don't End Up Short

A JET training aircraft was taking off at an air base located about a mile high. When it failed to become airborne after a ground roll of approximately 6400 feet on an 8000-foot runway, the pilot aborted. The plane slid off the end of the runway and was destroyed. The pilot received major injuries.

Although the elevation of the field was only a bit over 5000 feet above sea level, the density altitude at the time of the accident was 8700 feet. A computation of factors affecting takeoff performance showed that a ground roll of 6500 feet was required for takeoff at the temperature, pressure and aircraft weight involved in this instance. In other words the pilot aborted his takeoff attempt one hundred feet short of the point where the aircraft would have become airborne. It is apparent that the pilot was not aware of the longer takeoff roll required under the atmospheric conditions existing at the time that this accident occurred.

Recurring accidents of this nature have resulted in a TWX revising AFR 60-16 requiring jet pilots to compute the runway roll required for their particular aircraft and entering such in the remarks section of the Form 175. No longer can the pilot leap into his aircraft and take off with complete disregard for field atmospheric conditions. He must understand the effects of air density on the performance of his plane and consider these conditions when planning his mission.

Although this problem is relatively new to the pilot, aircraft and engine designers have always considered air density in their calculations. The performance of both aircraft and engines is dependent upon the density of the air in which they are operating. That's just plain common sense.

In the past the relatively good takeoff performance of reciprocating engine aircraft overcame this problem, and runway lengths were adequate under all but the most extreme conditions. With the advent of jet aircraft, however, the picture changed.

Without getting technical, density of the air varies with temperature and barometric pressure. Since the airspeed indicator operates on pitot pressure, which in turn is dependent on air density, the indicated takeoff and stalling speed will remain approximately the same for all density altitudes in the lower atmospheres. However, since the lift of the airfoil and thrust of an engine varies with the density of the air, the groundspeed and distance required for takeoff will increase as the temperature increases and/or pressure decreases.

The takeoff roll for an F-86D from a field elevation of 5000 feet with the temperature indicating 23°F. is 3800 feet. Approximately the same roll is required when taking off from sea level if the temperature is up around 95 degrees. Thus, it is fairly evident that both pressure and temperature enter into the picture when computing your takeoff distance.

Aircraft performance under varying atmospheric conditions has been calculated and tabulated in the Flight Handbook. The procedure is simply a matter of obtaining the pressure altitude and temperature from the weather station prior to filing your flight plan. With these two factors available, plus the known weight of the aircraft, the pilot can determine when the aircraft will become airborne by consulting the charts in the handbook.

Obtain the runway temperatures if possible, rather than ambient. It is not uncommon on hot, calm days for the temperature of the air near the surface of the runway to be as much as 10°F above the air temperature recorded at the station. A look at a takeoff chart will prove that under certain loading conditions such a spread could increase the takeoff roll to the critical point.

The Air Weather Service has recognized the importance of this condition and published a regulation (No. 55-33 dated 6 Aug 52), directing weather personnel to offer runway temperature observations for the pilot's benefit.

Obtaining a Dash-One and finding the correct table, then computing the takeoff roll is sometimes a lengthy process, especially when there are four or five guys ahead of you waiting to use it. Normally there is only one copy in Base Operations and thinkers at a few Air Force bases have come up with a streamlined method of accurately computing takeoff distances.

Blown-up charts for individual aircraft are prepared, indicating takeoff distances required for various fuel configurations under certain atmospheric conditions. After obtaining the temperature and pressure a pilot needs only to consult the chart on the wall to come up with the takeoff roll.

Granted, the requirement of obtaining the takeoff roll requirement and entering it on the Form 175 takes some extra time. It may come under the heading of a "headache" to many, but check this for size — since the inauguration of this requirement, there has been no recorded accident due to miscalculation of takeoff roll. ●

The flight planning portion of a mission has many facets. A systematic method of obtaining and applying this information is a necessity. A pilot must . . . .

# PLAN IT - FLY IT

MANY TIMES in the past FLYING SAFETY has pointed out to its readers the importance of the old saw . . . Plan your flight, then fly your plan. And we intend to keep hammering on the point until every USAF pilot and air crewman realizes the truth in the saying.

How will we know when such a time comes? Easily. Accident causes involving poor or improper flight planning will dive toward the bottom of the statistical compilations prepared by the Directorate of Flight Safety Research.

To paraphrase Thursday's famous Friday, "All you need are the facts, men." Getting the facts, all the facts, and applying them correctly is a necessity in any flight planning. In flight planning for jet aircraft it is more than a necessity; it's a must. Not because the problems differ when flying jets as compared with reciprocal aircraft. They don't. The same old problems of range, endurance and weather are there. But in jets they are magnified and become more acute. Short endurance is coupled with long range; various types of weather are encountered on one flight; letdowns are complicated by high fuel consumption at lower altitudes, and a pilot must think and react fast to stay ahead of his fast moving plane.

Consequently, jet flight planning must be detailed, more detailed than ever before. Weather, facility charts, NOTAMS, climb charts, cruise charts, letdown and low approach procedures all must be checked. Flight logs must be filled out accurately.

Sounds complicated and time-consuming, doesn't it? Actually it's not. About 30 minutes should suffice to prepare your flight plan and leave you with enough information to fill a small book. And remember, those 30 minutes might turn out to be one of the most important half hours in your life. At the very least, they can save you a ride on the silk and a long walk out of the boondocks.

### Weather Check

Before going in to beard the forecaster in his den, know exactly what you want in the way of information. You'll want to know what to expect at destination, while en route, at alternates and the forecast for your takeoff point.

Tell the forecaster the type aircraft you're flying, your proposed route, ETE, altitudes you expect to fly and any additional information that will assist him in visualizing your particular flight.

When the briefing is over your information should include:

*Destination:* Ceiling, visibility, freezing level, tops of clouds and precipitation, by type.

*En Route:* Ceilings, visibilities, cloud types encountered at various altitudes, turbulence at various altitudes, freezing level, temperatures aloft and winds aloft at various flight altitudes.

*Alternates:* Ceiling, visibility, freezing level, tops of clouds and precipitation, by type.

*Takeoff Point:* Forecast ceiling, visibility, freezing level and temperatures and winds up to flight altitudes.

Sounds like an awful hatful of facts, doesn't it? Actually, it takes only a few minutes to get the information. Once you have it, and apply it to your flight, you're all set. You know what to expect at destination, alternates and on-course in the event of an in-flight emergency.

Knowledge of the ceiling, visibility and freezing level at your destination is imperative. It's vitally important also to know the type and intensity of the precipitation which exists at your destination. Poor cockpit visibility may turn an otherwise routine approach into a fast session of low level acrobatics with disastrous results. And don't forget, knowledge of the precipitation, especially if it has occurred in the last hour or two, will warn you of possible poor braking action. Being forewarned about slick or wet runways can be the difference between an uneventful landing and one which resembles the sweeps and swirls of a champion figure skater.

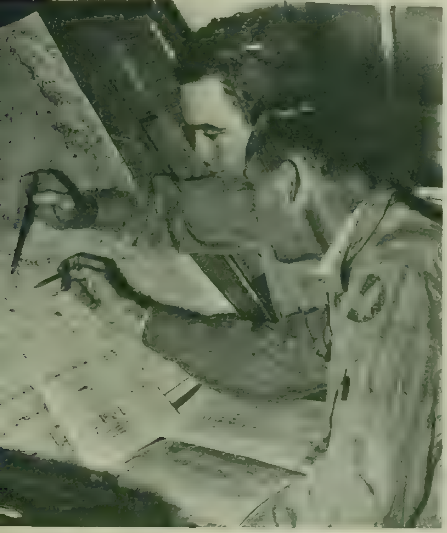
Temperatures and winds up to flight altitudes must be known to compute the distance to be covered during your climb and fuel to be consumed.

With a complete picture of en route ceilings and visibilities, valuable time is saved when an aircraft malfunction or other emergency forces you to decide where it is possible to land with the least difficulty.

The types of clouds at flight altitudes will give the pilot a good idea of the kind of low frequency radio reception he'll have. The presence of turbulence in the ice crystal zone will virtually assure that corona static will be present. Frequently ice crystal clouds will cause corona static of such intensity that the low frequency radio will be useless and all navigation must be by dead reckoning.

Weather at takeoff point is an item often neglected in flight planning. Knowledge of this weather will be the deciding factor when a decision must be made either to return to the original takeoff point or to continue to destination or an alternate in the event of an emergency soon after takeoff. Consulting a weather forecaster prior to takeoff may bring out a future weather condition that could make quite a difference in the pilot's flight planning.

A weather forecaster may bring out conditions that are not apparent to the casual observer.



Alternates should be chosen approximately 200 miles apart, or if possible, within gliding distance of the aircraft. Once selected, they are then readily available if the need for an alternate arises anywhere along the route of flight.

The facts on wind directions and velocities at the 10,000, 20,000, 30,000 and 40,000-foot levels must be accurate. Climb, cruise and letdown are predicated in part on winds aloft. Whether or not winds are beneficial or detrimental will play a part in determining your range. Remember, It may appear that headwinds on one leg will be compensated by tailwinds on another leg, but in jet operations this is not necessarily true.

The forecaster can give you the optimum altitude for your flight. This is the most efficient altitude at which the aircraft can proceed to the destination. Optimum altitude is given as density altitude and converted into pressure altitude, which the pilot reads directly from the altimeter, taking into consideration the temperature correction. The pressure altitude varies with warm and cold air advection aloft. In warm air, fuel is saved because the jet can fly at a lower indicated altitude and still be at optimum altitude for the flight.

During the briefing, you and the forecaster should go over a map which covers a large enough area to show the pressure system and frontal locations that will be in evidence during your flight. A pictorial cross section, if available, will show exactly what to expect in connection with the synoptic situation. Weather information portrayed graphically is much more easily assimilated and understood.

Under IFR conditions a minimum altitude below which the aircraft will not descend in the overcast should be decided upon. There is no problem at an established base where the latest altimeter setting is available, but a great change in setting is possible over a relatively short distance and a forecast altimeter setting can be cheap insurance. This is true particularly when letdown is made over mountainous terrain.

Inherent error in altimeters at high speed is a problem, but there is a simple rule-of-thumb method for compensating for error that can be used. For every mile per hour increase in airspeed over 200 mph, the altimeter will indicate one foot too high. As an example, at 600 mph the aircraft will be 400 feet lower than the altimeter reading.

A word from the weather man on turbulence also is important. Turbulent areas can cause real grief to a jet traveling at high speed. What might be merely light turbulence in a Gooney-bird traveling at 140 knots becomes severe turbulence when encountered at 450 knots.

### Operations Facilities

Loaded with your weather information, you're then ready to visit the operations office for a check of the radio facilities along the proposed route of flight. The Radio Facility Chart is your best source of this information. Your destination should be checked for length of runways, airport elevation, type of fuel available and jet starting unit. You should also check the status of radio range, GCA or ILAS, homing facilities, VHF/DF homer and obstructions (found in Pilot's Handbooks).

This information should be collected for each alternate airport. A check of NOTAMS will give the latest information pertaining to radio facilities and airport condition.

When you've completed your check of weather, radio facilities and airport condition, then make the final plans on your route of flight. If maps are used to plan the route, be sure to check all radio facilities against the Radio Facility Charts, NOTAMS and The Airman's Guide.

At this point in your planning, you are a fountain of information, but, as stated previously, you find that it didn't take a prohibitive amount of time to get the facts. Starting in the weather office and then working into operations eliminates those many trips back and forth picking up information which could have been gained in one chat with the forecaster. Then, too, if one piece of the information which you have helps to avoid walking home from your flight, you'll have saved one whale of a lot of time in the long run.

Forecasting your fuel requirements and flight time is your next step. Using the proper climb, cruise and letdown techniques, as required for your particular aircraft, it is possible to forecast fuel requirements within a few gallons and flight time within several minutes.

# PENETRATION . . . and Low Approach

JUDGMENT is a word that comes in two sizes, good and bad. Pilots have been exercising both sizes in airplanes for over half of a century.

Until the arrival of jets on the aviation scene, only a certain few phases of flight really taxed a pilot's ability to analyze a flight situation and exercise the proper judgment to take himself and his aircraft through the situation successfully.

With jets the frequency of situations demanding good judgment is stepped up considerably. The climb, cruise and the descent all present peculiar problems calling for sound judgment in any jet flight. The greatest of these three is the descent. The success or failure of many jet flights will depend solely on the judgment exercised in planning a descent from cruising altitude, whether conditions are VFR or IFR.

The Descent Chart in the pilot's Flight Operation Instructions contains the data necessary to plan a descent with the most favorable range-fuel ratio for your particular aircraft. The chart indicates the distance from destination at which a descent should be started, under a no-wind condition. It also shows the proper airspeeds to be used and the fuel which will be consumed in the descent, together with prescribed rates of descent. The data on the chart are based on a standard day with the power set at idle and the aircraft "clean," unless otherwise stated.

To illustrate the use of the chart, assume a cruising altitude of 35,000 feet on a standard day in a T-33. With the throttle in IDLE and the aircraft "clean," the initial rate of descent will be 1750 fpm at 230 mph (200 kts) CAS. The letdown should be started 54.5 nautical miles from a destination with a sea level elevation. The time required for the descent will be 8.9 minutes and the fuel used will be 18 gallons. The rate of descent and CAS are increased with the loss of altitude as shown on the chart, and these changes should be constant and smooth throughout the descent.

The Descent Chart just about whips the problem in a VFR descent. However, if the destination is IFR, other factors must be considered in planning a descent at destination. If the destination is IFR, a plan must be made for a penetration that is reliable, expeditious and positive, one that can be controlled by the appropriate control agency and which places the aircraft in the most advantageous position to make the type of low approach contemplated.

Experience has proved that it is very poor judgment to descend below 20,000 feet en route to a destination that is IFR, even if an expedited approach is assured. For example:

A jet reports over the fix at 10,000 feet. The pilot is advised to hold because ARTC has an aircraft at a lower altitude in the vicinity that has not reported over a designated fix, or Approach Control has cleared an aircraft to take off and the pilot of the departing aircraft has forgotten to report passing a designated fix. As a result, the incoming jet pilot must declare an emergency and descend through altitudes without positive aircraft separation.

Another illustration: A severe rainstorm has moved over the field and GCA cannot pick up the jet fighter, which has approximately 1/6 the reflecting area of an F-51. The ceiling and visibility are too low for a range approach and the jet, at 10,000 feet, does not have sufficient fuel to climb out and go to the alternate. The result is obvious.

If, however, the pilot remains at a minimum of 20,000 feet until reaching the fix and receives clearance, he is then in a position to make an approach within his capabilities or to proceed to an alternate.

Twenty to twenty-five thousand feet is a good altitude range in which to report over your destination fix. From this altitude your time for penetration is not excessive and you have altitude working for you in the event you must proceed to an alternate. If cruising at altitudes higher than these, use the Descent Chart in planning a descent to arrive over the fix at the desired altitude. By subtracting the

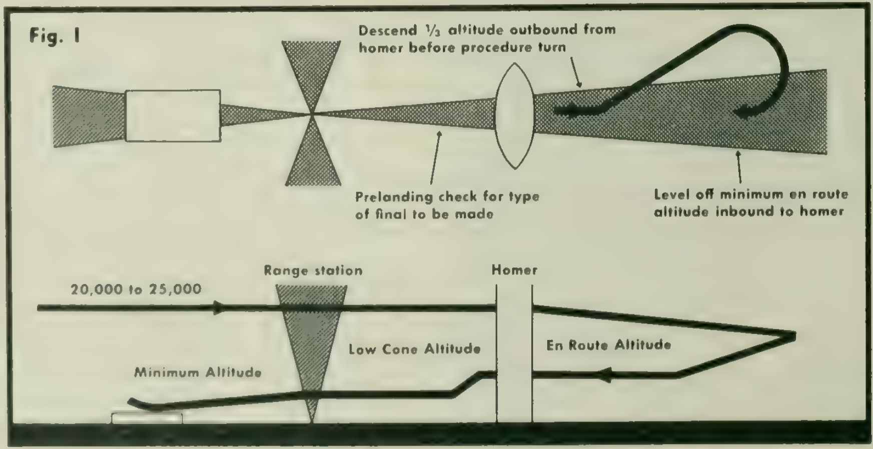


Fig. 1

Descend 1/3 altitude outbound from homer before procedure turn
Prelanding check for type of final to be made
Level off minimum en route altitude inbound to homer
Range station
Homer
20,000 to 25,000
Low Cone Altitude
En Route Altitude
Minimum Altitude

figures opposite the new desired altitude on the chart from those opposite the cruising altitude, you can determine the fuel, time and distance for the descent.

For example, a T-33 aircraft cruising at 40,000 feet is cleared to cross the destination fix at an altitude of 20,000 feet. Under a no wind condition, the chart indicates that the descent should be started 53.7 nautical miles from the fix; the descent will take 9.0 minutes, and 15 gallons of fuel will be consumed.

When the fix is reached, there are several methods of making a penetration, depending upon traffic conditions, terrain, fixes and approach aids available. It's a good practice to simulate penetrations in VFR weather from altitudes between 20,000 and 25,000 feet to determine the amount of fuel consumed during the penetration and low approach, the total elapsed time for the descent and approach and the ground pattern covered by the aircraft while making various types of penetrations.

There are many types of penetrations that can be accomplished successfully. Some of the various penetration and low approach procedures are described and illustrated on the following pages. Although the airspeeds, power settings and techniques are those specifically applicable to the T-33, by applying the proper airspeeds in knots they can be used in other jet aircraft.

### Types of Approaches

*Approach Using Homing Facility on Approach Bearing:* (Fig. 1)

This type of penetration and approach is ideal for jets when the homing facility is located on the approach leg of the range so that the low cone altitude provides terrain clearance for an aircraft descending inbound from the homing facility to the low cone.

The penetration is made from the homing facility, on the reciprocal of the approach bearing. Lose one-half the altitude before starting the procedure turn. Any airspeed, gear, flap and power combination can be used during the penetration, but the indicated airspeed must be held constant and the rate of descent must not be permitted to decrease. The aircraft must remain within reception distance of the radio aid and sufficient power must be used so that the pilot will get a reasonable amount of acceleration from the engine if needed and so that sufficient heat for the defrosters and anti-icers will be assured.

The recommended conditions for the F-80C or T-33 are 152 kts. IAS, full flaps, dive flaps, gear down and 65 per cent power.

After the procedure turn is completed, the level off is started 1000 feet (2000 feet in formation) above the minimum en route altitude for the range leg. The level off is accomplished by retracting the wing flaps completely without hesitation, raising the landing gear, and when 200 feet above the desired altitude, retracting the dive flaps. Research has shown that this is also the most satisfactory sequence for instrument level-offs.

The aircraft then proceeds to the homing facility at the minimum en route altitude at a power setting of 65 per cent. When over the fix, make the pre-landing check in preparation for the final approach, whether it be a GCA, ILAS, radio range or a combination of any of these approaches.

If for any reason the aircraft (T-33) should have to hold at a low altitude, the power should be adjusted to maintain a fuel pressure of 60 psi. Sixty psi fuel pressure usually can be held at 65 per cent rpm and a fuel consumption rate of approximately four gallons per minute results. Sixty-five per cent rpm is sufficient power to maintain airspeed and altitude in a turn using up to a 30-degree angle of bank with a fuel load of 200 gallons or less.

If a GCA or ILAS approach is used, lower gear, dive brakes and 35 to 60 per cent wing flaps on final approach and reduce the indicated airspeed to 130 knots. Add five knots per hour to the above airspeeds for each 100 gallons of fuel remaining in

## Jet Letdowns

JET penetration procedures are established so as to provide the least interference with conventional type aircraft, and to provide for the accomplishment of jet letdowns when conventional aircraft are held on the primary fix where the jet aircraft is executing letdown. In almost all cases the low cone altitude and the procedure turn altitude published in the jet instrument procedure are identical to the standard range approach.

* *Initial penetration altitude.* The altitude at which aircraft crosses radio facility for beginning penetration procedures. This altitude will be established for each procedure and will normally be specified as 20,000 feet MSL.

* *Penetration turn.* A one and one-half degree per second turn is made during the jet penetration procedure to return the aircraft to an inbound heading to the radio facility being used for the penetration. (The penetration turn may be either a level turn or a descending turn.)

* *Minimum penetration altitude.* The minimum altitude for the jet penetration procedure turn to an airport will be the initial approach altitude for the standard instrument approach procedure.

* *Initial approach altitude.* The initial approach altitude will normally be as shown for the standard instrument approach procedure. Where no initial approach altitudes have been established, a clearance of at least 1000 feet above all obstructions within a radius of 10 miles of the radio facility and 10 miles to either side of all penetration courses within an open quadrant for a distance of 40 miles from the radio facility must be provided except in mountainous areas. In all parts of the United States designated as mountainous areas a clearance of at least 2000 feet must be provided.

* *Procedure turn.* Will be executed as shown in the standard instrument letdown criteria.

* *Emergency altitude.* An altitude which will clear all obstructions within a radius of 100 nautical miles of the radio facility by 1000 feet except in mountainous areas. In mountainous areas the clearance will be 2000 feet.

Fig. II

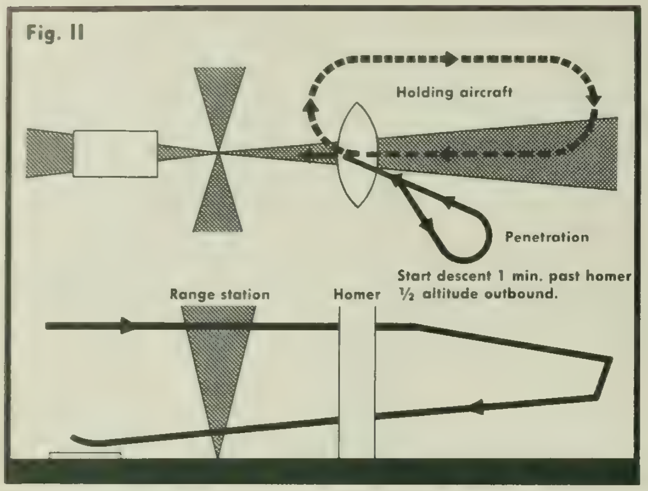
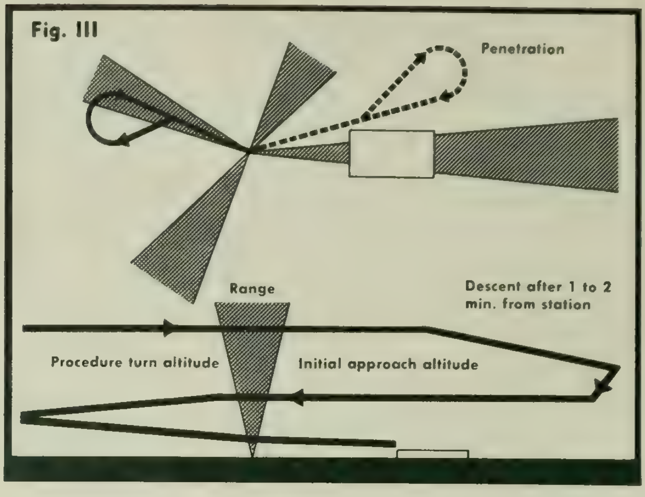


Fig. III


Penetration
Range
Descent after 1 to 2 min. from station
Procedure turn altitude
Initial approach altitude

excess of 200 gallons. Descend to the altitude which will intercept the glidepath at the proper point. Then adjust the power to maintain altitude and airspeed. The amount of fuel used in this type of penetration and low approach for the T-33 will vary from 65 to 70 gallons.

If a straight-in range approach is made, lower the gear after passing the fix inbound and descend to low cone altitude holding 174 knots. Upon reaching the low cone altitude, level off, permit the airspeed to drop off to 139 kts., then add power to 74 per cent to maintain this airspeed. The total fuel used in this type penetration and low approach from 20,000 feet in the T-33 is 60 to 65 gallons and the total time for the approach should be between 10 and 14 minutes.

### *Approach Using Radio Range Only (No Lower Traffic)*

Cross the radio range station at 20,000 to 25,000. Proceed out the range leg opposite the procedure turn leg. Lose one-half the altitude outbound as previously outlined. Return to the range station at the en route altitude of the leg you have just flown or at the procedure turn altitude, whichever is higher. Upon crossing the range station, execute a normal range approach as published for that station. Proceed from the station out the procedure turn leg not over one minute and thirty seconds at approximately 174 kts. (65 per cent in T-33) and descend to procedure turn altitude with dive brakes down. Upon reaching procedure turn altitude, raise dive brakes. Execute the procedure turn, and when on course inbound, lower the gear, hold 174 kts. and descend to low cone altitude. At low cone altitude, level off and permit the airspeed to drop to 139 kts., then add power to about 74 per cent to maintain 139 knots. Use dive brakes to descend from low cone altitude to minimum altitude, retracting them after reaching that altitude. This approach will take 60 to 68 gallons of fuel and 15 to 17 minutes total time. It can be made with a formation.

### *Approach in Open Quadrant Using Homing Facility (With Traffic Holding at Homing Facility) (Fig. 2)*

Proceed to the homing facility at 20,000 to 25,000 feet. Upon passing the fix, steer 45 degrees off the range leg into the quadrant which does not contain the stack. If there are no aircraft holding within 5000 feet below your aircraft, a descent can be started immediately. Descend one-half the altitude outbound as described above, continue descending in the procedure turn, return to the homing facility at the assigned altitude and make an approach straight in; GCA, ILAS or radio range.

If aircraft are within 5000 feet below you, proceed out into quadrant one minute or more before descending. Then proceed as above. This type of penetration and approach takes 60 to 70 gallons of fuel and approximately 14 to 15 minutes.

### *Approach With Traffic On All Legs of the Range and No Homing Facility Available* (Fig. 3)

In the event through traffic or holding traffic have all legs of the radio range occupied, proceed as follows: Cross the range station at 20,000 to 25,000 feet and proceed outbound (terrain permitting) on the bisector heading of either of the quadrants which has the landing field located on the range leg separating them.

To avoid descending through occupied altitudes on the range leg, level flight is maintained on the outbound bisector heading until clear of the range leg and/or the airway, normally one or two minutes depending on ground speed. The penetration is made as described above for the radio range approach except, instead of descending on the range leg, the penetration is made in an open quadrant. Return to the range station at an assigned altitude from which a normal range approach, GCA or ILAS can be made. Eighty to ninety gallons of fuel will be consumed and the approach will take 16 to 18 minutes total time.

If a GCA is made using a rectangular pattern after returning to the range station, approximately 110 gallons of fuel will be consumed and 18 to 23 minutes required for the complete letdown from 20,000 feet to touchdown. It's a good idea to request GCA to pick you up inbound upon completion of the procedure turn for a straight-in GCA. With proper planning, a track can be flown from the range station to get in position for a straight-in GCA approach.

These are only a few of the basic types of jet approaches that are available to a pilot in the event a letdown is necessary. As you can see, no one type of penetration fits every situation. Judgment, once again, determines your choice of method.

The old, old method of "Ready or not, here I come" just doesn't fill the bill for jet IFR letdowns. ●

# ENGINE ICING

THE GRADUAL but definite transition of the Air Force from reciprocating engines to gas turbine oower plants has demanded a coresponding change in operating proedures, techniques and planning.

Many of these changes are strictly perational in nature and are readily inderstood by pilots, while others ire more technical and somewhat ague in the minds of most operating ersonnel. Into which category the roblem of dealing with jet engine cing falls is controversial, but it is nteresting to note that the operating ommands at this time try to avoid light in icing conditions even though heir aircraft may be equipped with nti-icing provisions. Also, many resent operational jet aircraft are owered with gas turbine engines vhich do not incorporate anti-icing rovisions and therefore should not e flown in icing conditions.

All current operational turbine enines that have anti-icing features uffer definite limitations with which ilots should be familiar. A deficiency s encountered in the anti-icing sysems during flight at medium and ower power setting and is an inherent haracteristic of this compressor bleed ype anti-icing principle.

There are two definite limitations hat affect actual engine operation in cing conditions. The first is the effect f ice accretion blocking airflow into he engine, subsequently causing overemperature conditions in the turbine ection or loss of thrust, or both.

The second limitation is the inbility of an axial compressor to diest chunks of ice without damage. hese chunks of ice may be dislodged rom forward inlet components such s inlet cowl lips, duct dividers and accessory dome. Several instances have been recorded during which J-47, J-35, T-38, J-21, J-73 and J-65 engines have been damaged by ice ingestion. One of these occurred on a B-47 during flight in which one engine completely disintegrated and the five remaining engines were damaged beyond repair. Obviously, engine damage due to ice ingestion on a single engine aircraft could result in loss of the aircraft.

Ice ingestion tests have been run on some gas turbine engines in an effort to establish their resistance to ice ingestion but no definite conclusions have been reached. It must, therefore, be assumed that all current axial flow gas turbine power plants are susceptible to compressor damage by ice ingestion.

The initial indication of jet engine icing is increased exhaust gas (tailpipe) temperatures. This is all too often the only indication prior to complete engine failure.

Ice forms on the fixed or extended inlet screens and compressor inlet guide vanes (stator) and restricts the flow of inlet air. This causes a loss of thrust and a rapid rise in tailpipe temperatures. As the airflow decreases, the fuel-air ratio increases, which in turn raises the temperature of the gases going into the turbine. The fuel control attempts to correct any loss in engine RPM by adding more fuel, aggravating the condition.

Complete turbine failure may occur in a matter of seconds after ice builds up in the engine air inlet. Critical ice build-up on the inlet screen can occur in less than one minute under severe icing conditions.

The idea that heating due to ram pressure at high speed will prevent icing is erroneous. The heat generated at subsonic speed is insufficient to prevent ice formation.

Serious inlet duct icing can occur without the formation of structural ice, and it is necessary to understand what causes this icing to anticipate it. When jet aircraft fly at velocities below approximately 250 knots TAS and at high power settings, the intake air is sucked instead of rammed into the compressor inlet. This suction causes a decrease of air temperature (adiabatic cooling). Under these conditions, air at an ambient temperature above freezing may be reduced to sub-freezing as it enters the engine.

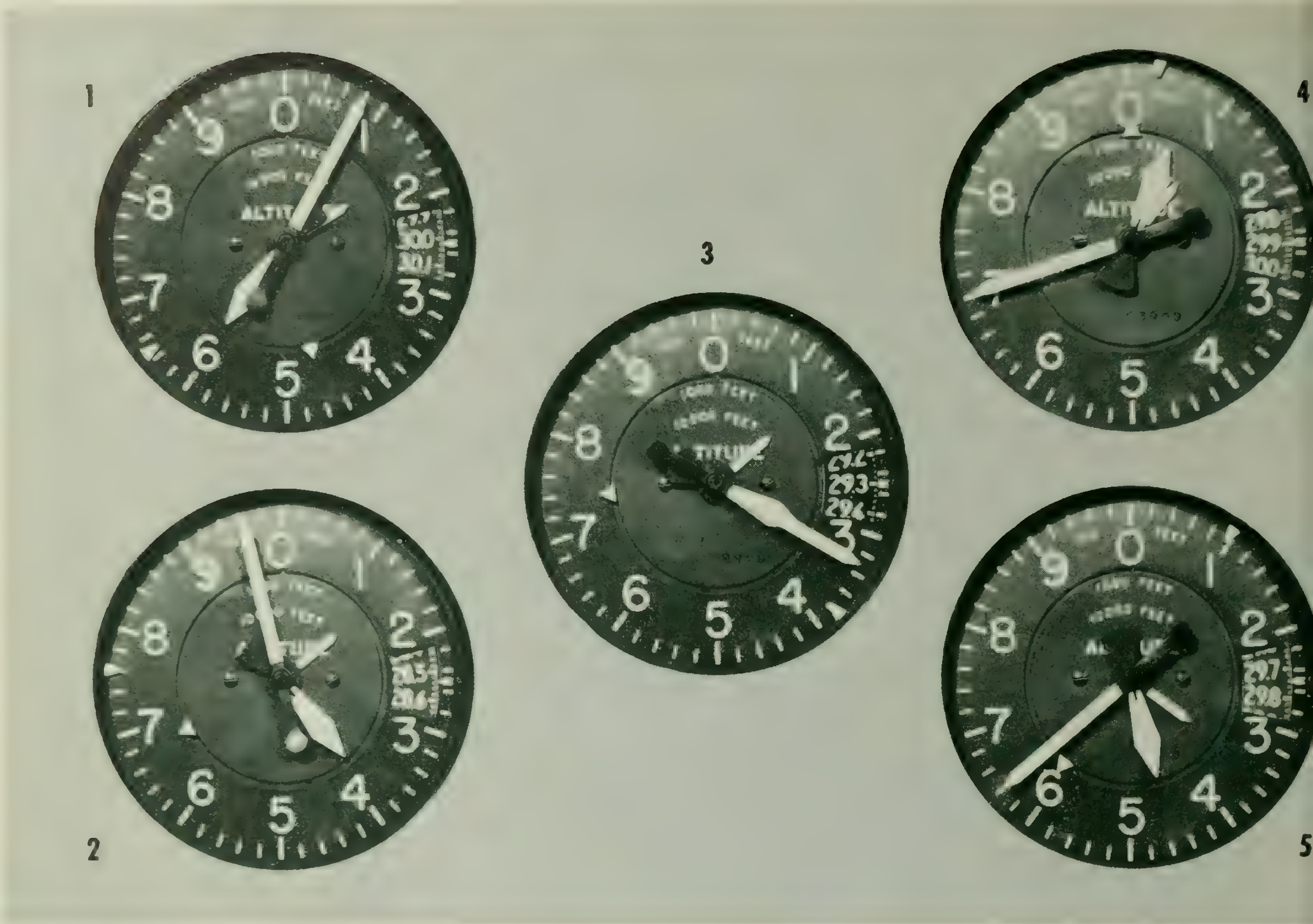
The maximum temperature drop which can occur in most jet engines is about 5°C. The max temperature drop occurs at high RPM on the ground and decreases with decreasing RPM and increasing airspeed.

In sub-freezing temperatures, the *rate* of icing increases rapidly at speeds above 250 knots but the *amount* of accretion decreases. Therefore the pilot may either increase speed to get out of the area quickly or decrease speed and reduce the rate of accretion if rapid departure from the icing area is impossible.

Procedures to be used in the event icing conditions are encountered are covered in most pilots' operating handbooks and should be followed to the letter. However, in that some Dash Ones are completely devoid of any instructions pertaining to jet engine icing, Technical Order 01-1-469 (Operation of aircraft with jet engines under icing conditions—all jet aircraft) was reissued. Although somewhat general, this T. O. contains important operating instructions which should be read and adhered to by all personnel cleared for operation of jet aircraft. It outlines recommendations with respect to operation of non-anti-iced axial flow turbojet engines in icing conditions.

If icing is encountered, immediate action should be taken to get the engine anti-icing system into operation; change altitude or vary course to avoid clouds; reduce airspeed when in freezing air, and reduce engine RPM as necessary to prevent any excessive tailpipe temperatures.

It is well to remember that present anti-icing systems are not always adequate protection from all meteorological conditions. Therefore, it is still good advice to pilots to "refrain from flight in icing conditions unless the mission dictates it." ●



# Don't Chance a GLANCE!

*Reading an altimeter ought to be as easy as telling time, but is it? Studies by the Aero Medical Laboratory show that at certain settings, the three-pointer altimeter is particularly susceptible to misreadings of 1000 and 10,000 feet.*

*This is most likely to occur when the sensitive pointer is approaching zero on the scale. If a pilot misreads his altimeter by a wide margin the results are obvious. And recent accidents prove how easy it is to do just that. Don't be a statistic. Be sure you read your altimeter correctly.*

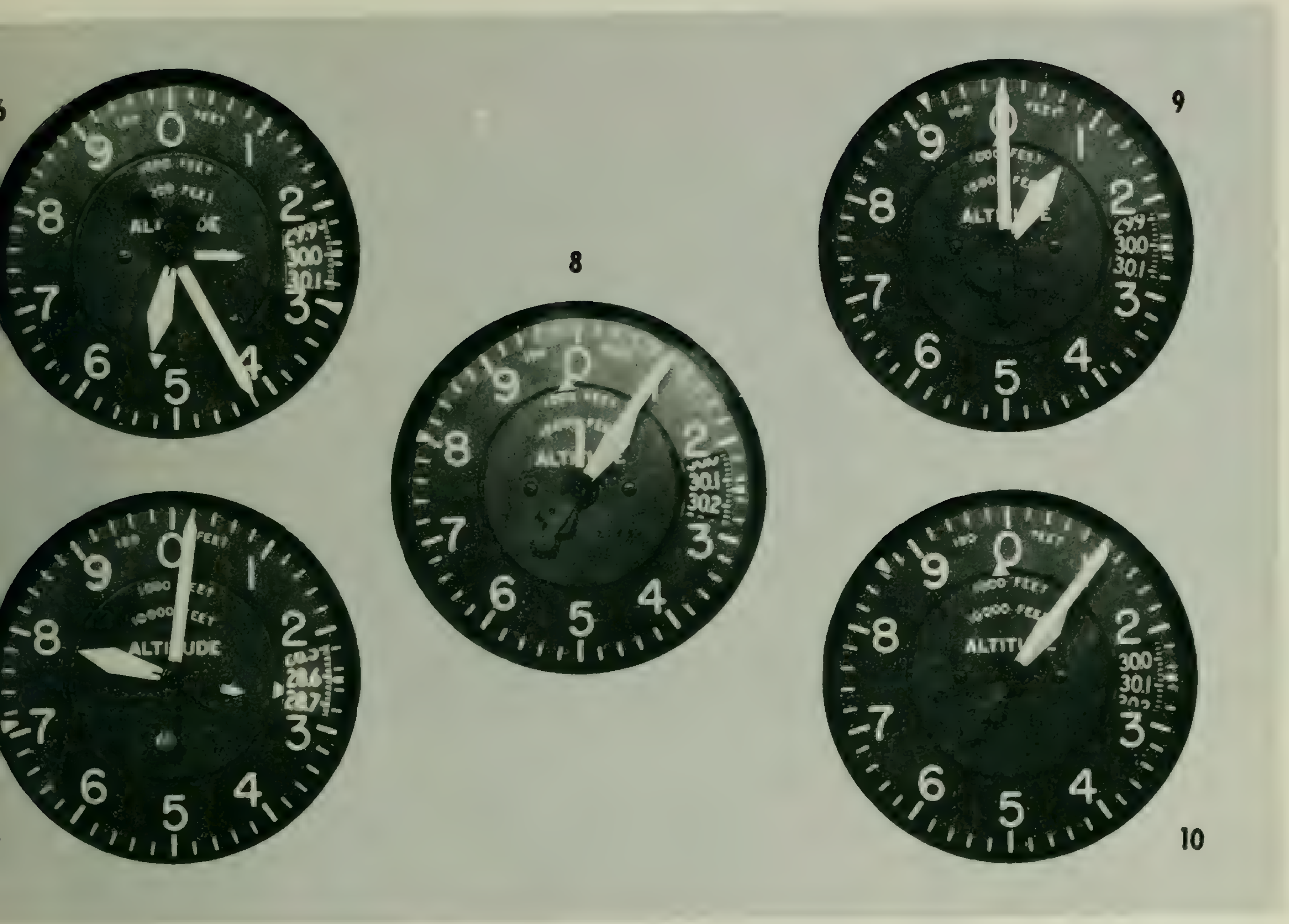
*Check your answers to the above altimeter quiz on page 22.*

SLAP A layman into the seat of a modern jet fighter and the mass of dials on the instrument panel will send him off talking to himself. One of his more classic remarks may be "I don't see how those pilots can keep up with all those whirling, jiggling needles and dials." He has a point, you don't keep up with *all* of them.

Any pilot could tell him that there are only certain ones you watch at certain times. The primary instruments to watch during level flight differ from those used during an IFR letdown. You concentrate on a specific few and merely glance at others for cross-checking and reference.

This brings up the important consideration of how much can you see at a glance? Under marginal cockpit visibility often a glance isn't enough and it can result in misreading an instrument. Tests conducted by the Aero Med Laboratory indicated that for the conventional three pointer altimeter, 11.7 per cent of all readings were in error by 1000 feet or more. To further prove a point, pilots used in these tests were given approximately seven seconds, which is considerably longer than a glance.

Magazine articles, flying safety meetings and hangar talks have been centered around this subject, and most pilots are cognizant of the altimeter's inherent readability limitations, yet incidents continue to occur.



The problem seems to be that while a pilot is concentrating on flight attitude instruments, radio conversation and instrument procedures, that quick look at the altimeter often results in misinterpretation.

A flight of three jet fighters recently accomplished three low approaches to a field that had a 4000-foot ceiling. They never became contact! During their letdowns the recommended altitudes were relayed to the flight leader by the PPI controller. (PPI approach equipment does not incorporate elevation indicators.) On one approach the controller instructed the flight leader to descend to 800 feet and vectored the flight right over the field. The flight leader acknowledged but still never broke out of the solid soup. Following the third attempt, all three pilots abandoned their aircraft because of fuel shortage. Three minutes later another flight of three broke out VFR at 4200 feet after a similar PPI run.

Investigation definitely established that the leader of the first flight misread his altimeter by 10,000 feet and never descended below 10,800 feet.

Several months later, thousands of miles from the scene of the first incident, four more jets were making a night IFR beacon approach. Procedure turn was to be performed at 11,000 feet. The flight reported procedure turn, and upon turning inbound, suddenly broke out of the overcast with their airscoops just clearing the tree tops. Yes, they were at 1000 feet, not 11,000. Another case of misreading the altimeter by 10,000 feet.

Inspection of the altimeter will readily show that at certain altitudes the 10,000-foot indicator is completely covered by the 1000-foot needle. Even with the needle not covered, it is small and hard to see, especially at night.

Although the 10,000 indicator is the big problem child, there are many recorded incidents where errors of 1000 feet jump into the picture.

A pilot of a bomber plane began letting down from an altitude of 6000 feet. At 1000 feet the copilot expected him to level off. Instead the pilot kept right on letting down until the copilot took over. The trouble was that the pilot had misread the altimeter by 1000 feet.

Just how many unsolved accidents involving aircraft flying into the ground on IFR approaches were caused by misreading the altimeter is problematical, but it should make you think. It should make you think, then assume, "that it doesn't always happen to the other guy."

Wright Air Development Center realizes the problem and is currently developing and testing new instruments designed to give a clearer presentation of altitude. But, until a new one is developed, we have to live with the hard-to-see altimeter with the hide-and-seek 10,000-foot needle. ●

In high performance aircraft, on a collision course, you have only . . .

# Short Seconds!

**Colonel H. G. Moseley, USAF (MC), Chief, Medical Safety Div., D/FSR**

RECENTLY a pilot who was undergoing training in a jet fighter aircraft returned from a skip-bombing mission and was somewhat concerned when his crew chief pointed out several dents in the leading edge of the wing, scratches on the bottom of the aircraft and pieces of Yucca cactus embedded in an air scoop.

In this foliage-gathering mission, the pilot's wingman, who was flying behind him, was impressed with the low level of the pass, so low indeed that jet wash raised considerable dust in the passing.

All of which might be placed in the "Tut-tut, don't-do-it-again" category except for the fact that a number of other pilots have had similar experiences but leveled off a few feet lower, with rather dramatic results. If the pilot had stopped to calculate his dive angle and closing speed toward the ground, he would have realized that at the time he began his pull-out he was angling toward the ground at the speed of some 500 feet per second, and if he had delayed his pull-out as much as 1/50th of a second more, well . . . ??

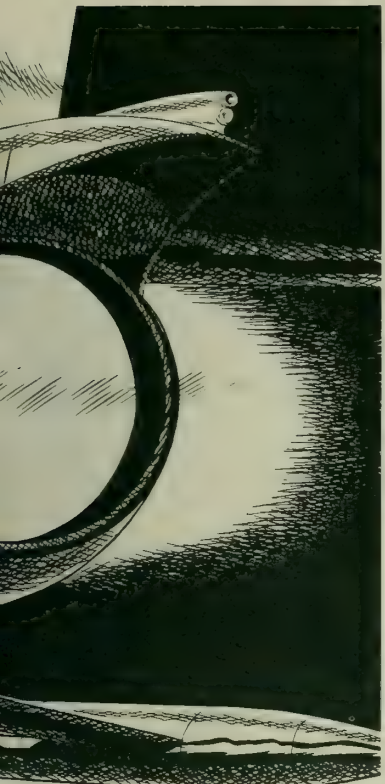
There is little doubt but that the pilot was sincerely attempting to fulfill his mission of bouncing a bomb through a target and that he did not wilfully intend to give his wingman a case of near-nervous collapse by the maneuver. His near-miss was inadvertent for he would never have had this mishap had he realized the vital importance of two factors, both of which every jet jockey needs to know and respect. These factors are, first, the terrific, almost unreal rate of closing speed in high performance aircraft and, second, the built-in limitations of man whose reactions are appallingly slow when pitted against the rapidity of events that may be encountered in high speed flight.

Closing speed of high performance aircraft is something rather new to the human race. To grandfather it never meant much more than an occasional collision between a buggy wheel and the front porch step during the haste of getting grandmother to church. Even to father in the day of the Model T it seldom meant more than a crumpled fender and a ruffled disposition which could be straightened out by means of a pair of pliers and a bottle of cold beer, respectively. The driver of the modern car, however, has begun to learn more about closing speed and to respect it. The relative ease with which man has encompassed this new challenge is somewhat of a tribute to his ingenuity. Within a very few years he has learned to glance at oncoming traffic and decide with a certain degree of accuracy his ability to pass safely the truck in front of him. Subconsciously he has developed a third dimensional gage of a new phenomenon. And, one might add, Monday morning's papers contain some interesting observations on those who were unable to learn.

Yet, in spite of his experience on the highway, when man pilots a jet aircraft he encounters closing speed which has no earthly comparison, and whose significance he has not yet learned to interpret at a glance. Therefore, it may be appropriate to take a more or less typical fighter mission, dissect it, and look at the anatomy of this strange new force.

### Typical Fighter Mission

Inasmuch as high-angle strafing and bombing attacks are common maneuvers, we can take a high-angle strafing mission in an F-86 and roll in at 10,000 feet and pull out at 1000 feet above terrain. Fortunately, it takes no Einstein to understand the time-space anatomy of this situation. There are just three factors in it: *direction, speed and recovery.*



In this mission direction is simple; once the nose of the aircraft is pointed 45 degrees below horizontal, it is established. There is only one nasty little complication. This will become apparent later.

The next factor is speed. This also sounds simple; once a velocity of approximately 450 knots is established we have the speed. Any questions?

At this point all who have no questions might reconsult their insurance agents, because just as two and two equal four there are two factors built into the problem which, if unaltered may add up to an untimely end.

These factors are vital because the direction is down, and, to state it mildly, the aircraft is moving. As a result a collision with the earth is sooner or later inevitable. Therefore, in any mission where speed toward the earth is established there must be an accompanying and equally important consideration of time. Not knowing the minimum length of time that the speed and direction may be maintained before change is essential can be placed in the same category as not knowing the gun was loaded.

There are many charts showing how long it takes to lose altitude in various degrees of dives at various speeds. An example is Chart A. In this mission we start at 10,000 feet and pull out at 1000, indicating that we have 9000 feet of altitude to lose. As can be seen by the chart, at 450 knots 9000 feet in a 45-degree dive will be lost in approximately 17 seconds. However, if we hold the dive for 17 seconds we will commit one more unpardonable error—that is the error of allowing insufficient time for recovery. Recovery is the last major factor in the relatively simple anatomy of a dive. However, we should take a long, careful look at this item, for recovery from a high-angle strafing mission brings into sharp focus some of the most critical hazards of closing speed.

Flight surgeons and scientists have gone into long dissertations and have written reams concerning acceleration, G force and other physical laws of time, motion and space that are involved in changing the speed and direction of flight.

### Momentum and Inertia

The factors which most directly confront us in recovering from this dive are the forces of momentum and inertia. One of the peculiarities of nature is that when something is moving, it keeps right on moving in a straight line until it meets some form of resistance. And the heavier the object and the faster the speed, the more resistance it takes to slow it, turn it or stop it.

This tendency to keep on going is due to the object's momentum and inertia, and for the sake of simplicity we can think of these forces together as momentum. A baseball, after being pitched, continues in the direction it is thrown, due to its momentum, and it is stopped by the resistance of the batter, the catcher, the solid earth or the friction of air. If a rock the size of a basketball is thrown with any force, neither the batter nor the catcher can stop it effectively, and it will take considerable friction to overcome its momentum.

In the F-86 high-angle strafing mission we have committed several streamlined tons of aircraft to a speed approximately that of a .45 caliber bullet. Here we have momentum in truly awe-inspiring proportions, and it is momentum which will require tremendous resistance to change. Unlike the baseball, the only acceptable form of resistance we can use is the friction of air. With this friction we must both slow down the dive and change the direction of the aircraft by at least 45 degrees.

A speed of 450 knots is considerable, and a jet aircraft, even with dive brakes extended, does not offer much surface for effective atmospheric friction. Therefore, we need both time and distance to overcome speed. In fact, we need so much time and distance to slow a nose-down dive that reduction of speed is only of minor importance in our problem of recovery. What is of paramount importance is a change of direction.

It is the item of change in direction which is the toughest problem of all. It is something that every pilot is constantly confronted with, and it is so closely tied to fundamental laws of nature that it must be given monumental respect if human flight is to be successful. As we mentioned above, momentum tends to keep an object going at the same speed and in *the same direction* until it meets resistance. Thus, when an aircraft's nose is pulled up, the pilot tends to go on in the original direction, and G forces are created. These same G forces work on the aircraft structure and wings, and the more rapidly the direction is changed the greater becomes the physical laws pushing the aircraft and the pilot straight ahead. After a point neither the pilot nor the plane can any longer defy this force, and unconsciousness or disintegration occurs.

### Required Pull-out Time

It is appropriate here to look at Charts B and C to see the length of time which will be required to pull out of a 45-degree dive at 450 knots, at both 4 and 6G. At slower speeds less altitude is needed than is shown on the charts. However, the amount of G that can be used effectively on the aircraft and the time required to recover at this speed, must be computed well in advance. If insufficient time is allotted and the aircraft is committed to too low an altitude before recovery is begun, momentum and inertia, following the inexorable laws of nature, will take over and commit the aircraft to disintegration in the air or collision with the earth, no matter what efforts, threats or appeals the pilot may use.

The amount of altitude needed for recovery must be carefully computed, because it is least subject to compromise, and this altitude must be added to the distance above the

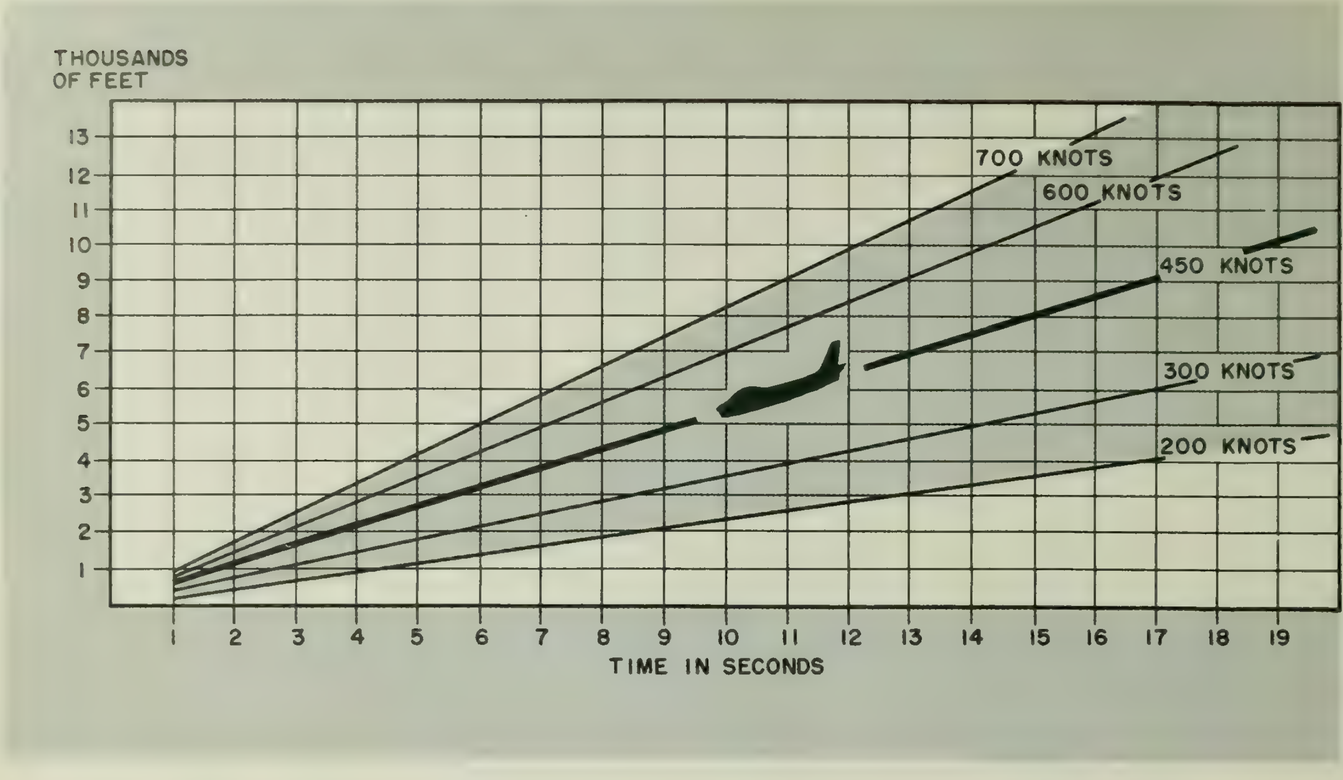


**Chart A. As shown by the chart, at 450 knots in a 45-degree dive, 9000 feet will be lost in about 17 seconds.**

ground wherein level flight is desired. Above that can be found the time allowed for aligning, sighting and firing. The successful pilot will know full well this time factor, because the seconds computed will be far more exact than his altimeter, and frequently more reliable than his vision.

For those who wonder why the altimeter is not reliable, it is relevant to note that a target and an altimeter cannot be simultaneously watched, and it is even more relevant to note that in high-speed dives the altimeter lag places the aircraft many hundreds of feet nearer the earth than is shown by the instrument. For those who wonder why vision alone is not a good substitute for timing a dive, it is well to consider the limitations of man and his reactions.

In considering man and his reactions, we can briefly review another accident. It is also true. It is chosen because it is typical rather than bizarre. The factors which caused it are still present. These causes are unchangeable. Only by knowing them can we prevent repetition.

This accident had its inception when a pilot, flying a jet interceptor found it rather monotonous making the usual camera gunnery passes at a bomber and requested permission from the bomber pilot to make a head-on pass. Permission was granted, and the interceptor pilot moved out ahead, oriented himself and waited for the bomber to appear. Eventually he sighted it approximately three miles distant and coming toward him. He swung in for his pass and then pulled up over the left wing of the bomber and away. He immediately noticed a severe yaw accompanied by buffeting and found that he had a ruptured right tiptank. He determined that his aircraft was controllable and returned to his home station and landed successfully.

The fate of the bomber was different. With a piece of the wing sheared off by the interceptor tiptank, it went out of control, partially disintegrated in the air and crashed. There were no survivors.

Neither the bomber nor the interceptor pilot realized the odds against them when they set up this simulated attack. It is certain that had they realized it, they would never have tried the maneuver. Let us review the cause factors in this accident, because, as mentioned before, they are still present.

Primarily this simulated attack, like all head-on attacks, created a formidable closing speed. The bomber was traveling at 170 knots indicated, and the interceptor was coming toward it at 350 knots indicated. Thus, at their altitude they had established a closing speed of approximately 1100 feet a second. The rest is a story of human reactions.

### Reaction Problems

In considering man's reactions when confronted with such closing speed one finds that the first problem is one of visibility. Even on perfectly clear days it is difficult to see an approaching aircraft until it is quite close. The greatest distance at which a bomber can be seen is a little over seven miles, and a fighter a little over five miles. However, the probability of seeing an aircraft at such distance is about as great as seeing a grain of sand somewhere on a rug. It is not until an object is near enough to be relatively large that it is usually seen, even when searched for. So, the interceptor pilot first recognized the bomber when it was about three miles away. In some respects he was lucky, he might have been much closer before recognition dawned. If he had not been searching, he might not have seen it at all.

However, the interceptor pilot did locate the bomber at a distance of approximately three miles. Here is where the plot really thickened, because while closing at a rate of 1100 feet a second, a stubborn, uncompromising factor called time lag stepped in.

What does time lag mean? It means it takes approximately 1/10th of a second for the nerves to carry what the eye sees to the brain. And it takes approximately one second for the brain to recognize what it sees.

In turn, it takes approximately five seconds for the brain to make a decision when there are several choices. For instance, to decide whether to turn the plane up or down, right or left.

It takes approximately 4/10ths of a second for the nerves to carry that decision to the muscles and make them move.

What did this time lag mean to the interceptor pilot? It meant 110 feet in the 1/10th of a second for sight to reach the brain. It meant 1100 feet in the one second for recognition to take place. It meant 5500 feet in the five seconds spent in deciding how to line up. It meant 440 feet in the 4/10ths of a second to react. All in all, it meant 7000 feet from the time the bomber was seen until it was lined up.

The die had been cast. Now the end was inevitable. Considering that the bomber was first seen at about three miles, or approximately 16,000 feet, and considering that 7000 feet were lost in the line-up, we now have 9000 feet separating the two aircraft, and it's time to fire away.

Here, again, time factors are encountered. We hold the course and squeeze the trigger. Four seconds and 4400 feet. We recognize we are getting close. One second and 1100 feet. We decide to break away. Luckily, the decision was made in advance of the attack to break up and to the right. No complicated choice here. Only one second for a decision. Only 1100 feet. And now only 4/10ths of a second to react to that decision; only 440 feet. However, we have precipitously obliterated another 7000 feet of vital separation distance.

Chart B shows altitude lost in pull-outs from 30, 45, 60, 90-degree dives from 10,000 ft. at 6G.

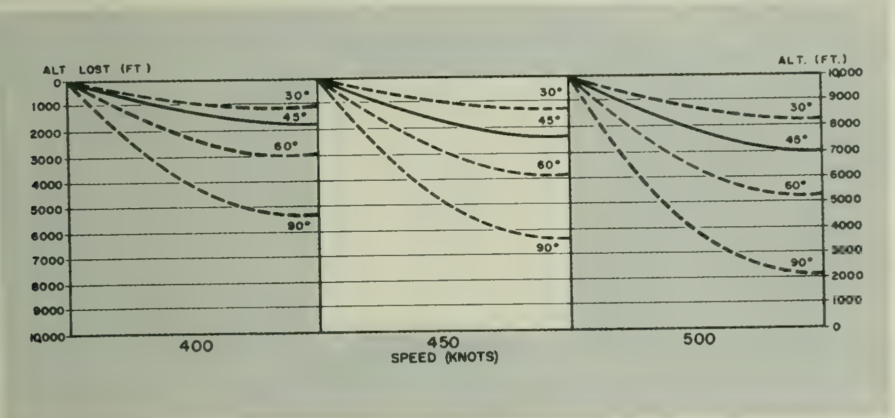
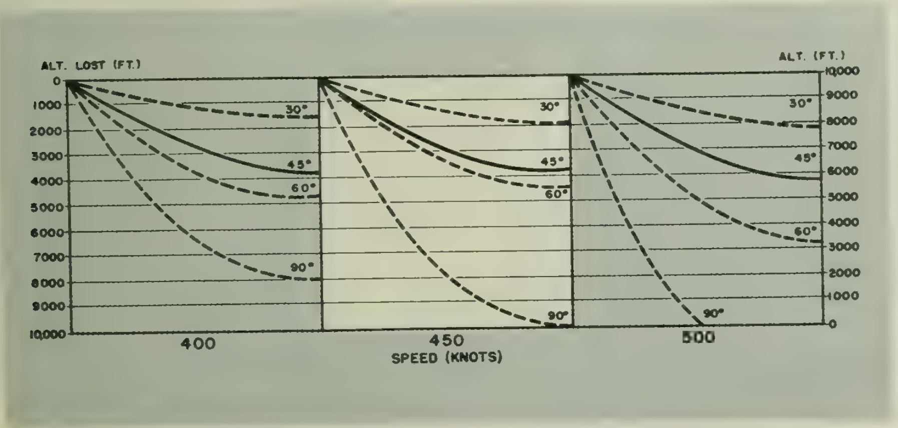


Chart C shows the increased altitude loss when pulling 4G instead of 6G at various dive angles.



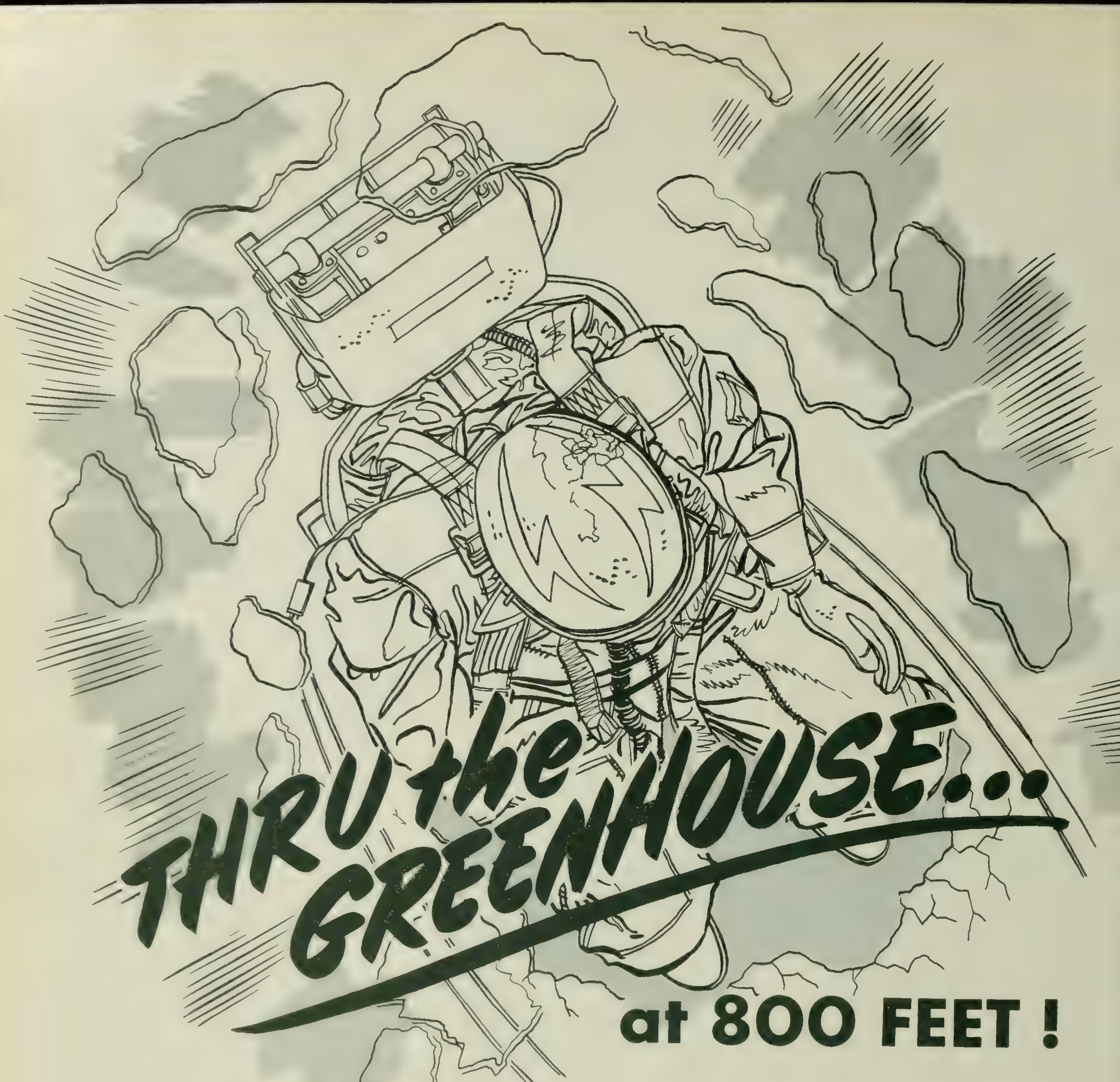
How much space remains? Approximately 2000 feet now separate the aircraft, and evasion has begun. Only it is started too late. Here, again, time lag steps in. This time it is not the lag inherent in the reaction of the pilot, but the time lag in the aircraft itself. It takes time to stretch the cables. It takes time to move the rudders. It takes time to change the airflow over the controls. Especially, it takes time to change the tons of momentum from their near-irresistible course. How much time elapses between pressing the controls and significantly changing the course of an aircraft? That isn't known exactly. Certainly more than a second. Probably more than two seconds. Some observers say five seconds.

In this case there were two thousand feet between the two aircraft; 1100 feet a second. Time ran out. This pilot learned the hard way.

Yet, those who cannot remember the past are condemned to repeat it. Recently two experienced pilots in jet fighters, disregarding instructions, decided to fly a head-on pass. It was the same story. The pattern was similar. Not much distance when they first saw each other. A fraction of a second for sight to reach the brain. A second for recognition. A few seconds for decision. A fraction of a second for reaction; another few seconds to decide upon the breakaway. It was their last earthly decision. Little else could be expected. Their closing speed at this point was approximately 1700 feet a second.

However, the true significance of closing speed and human reaction does not lie in making head-on passes. It lies rather in the fact that in spite of high velocity and man's slow chemistry, flight can be eminently successful. Although the laws of nature appear to stand rigid and immutable in the paths of aerial conquest, they can be circumvented. To this end man has established the codes and rules of flying. Thus, the warnings of minimum altitude are designed to neutralize the momentum encountered in a strafing mission, and the rules of air traffic are established to avoid the awesome closing speed of on-rushing aircraft.

It is a wise pilot who will know well and abide by these rules of the game. He cannot change the laws that make them necessary. Nor can he alter the penalty of disregard. ●



# THRU the GREENHOUSE... at 800 FEET !

WITH the introduction of high performance jet aircraft, the development of the ejection seat logically followed as a solution for escape at high speeds during an emergency. Naturally this escape device is intended for use only when the pilot has no alternative except to eject.

The ejection seat has met a great many needs associated with in-flight emergencies; however, it is felt that all the advantages of ejection have not been exploited fully.

Emergency ejection from a high speed airplane must meet one requirement. Namely, the pilot must clear the aircraft structure just as he did in older conventional aircraft. The ejection seat is doing the job, but there are complications, particularly when we consider the complexity of the various systems and the all-important *time* factor. The pilot, being attached to a heavy seat structure, must have time in which to separate from it, prior to deployment of the chute.

In other words, there is a time element involved in separation from the seat which, at low altitude, has been precarious because of the delay between unbuckling and kicking free of the seat and opening the parachute.

It is the opinion of many pilots that the ejection seat trajectory can be put to excellent use by utilizing the traversed arc. Additional altitude above the terrain can be realized if separation from the seat is possible at or near the top of the arc thereby giving the pilot additional time in which to deploy his chute.

We may be asked, "What should be the objective in successful ejection from an aircraft relative to terrain clearance?"

It is our belief that all jet fighter pilots would categorically state that the objective should be successful

ection and parachute deployment at
*y elevation* immediately following
eir takeoff.

It is realized that this objective may
ver be reached; however, it is possi-
e at *this time* to evacuate an aircraft
extremely low altitude provided
rtain conditions are met. Ideally,
ese conditions are:

- Ejection through the canopy of jet fighters at the *choice* of the pilot.
- Automatic separation from the seat.
- Automatic deployment of the parachute.

Time is of the essence in an emer-
ncy bailout at low altitude and the
lot should be given the choice of
ttisoning the canopy or ejecting
rough it. Incorporated within this
ticle is a list of jet aircraft that
nploy emergency systems which give
e pilot that choice. It is the belief of
e Directorate of Flight Safety Re-
arch that a pilot should be given the
noice, because an ejection system
at is first dependent upon successful
ttisoning of the canopy could be
ade inoperative by battle damage or
her malfunction and the pilot would
ereby be trapped.

Some non-believers have been
gainst ejection through the canopy
the pilot's choice because of the
ossibility of injury to the pilot as
e canopy is penetrated.

We believe the ejection seat can be
esigned in such manner that it can
enetrate the canopy without injury
the pilot. This requires a penetra-
on device that would precede the
ilot's head and shoulders and would
nly be impractical in those cases
here the canopy had been strength-
ned to a point where no ejection seat
ould break through.

We now have positive evidence that
is possible to go through a canopy
uccessfully, protected only by nor-
al flight gear. In the instance that
ollows, the pilot was given two of the
hree essential escape devices. He had
he *choice* of ejecting through the
anopy and he had an automatic lap
elt. However, he had to deploy his
arachute manually.

Recently 2d Lt. William R. Hill,
n instructor pilot at Williams AFB,
nade a successful low-altitude bailout
hrough the canopy of a T-33. The
Directorate of Flight Safety Research,
ealizing the value of wide dissemina-
ion of his story selected this means
f spreading the word.

This is the first successful ejection through the canopy, at very low altitude, on record. The pilot who was involved in this ejection got clear of his aircraft at an altitude of approximately 800 feet above the ground. Airspeed at the moment of ejection was nearly 280 knots.

The following are direct quotes from Lt. Hill's narrative account of his emergency ejection.

"The events leading up to my bailout were, in general, very much routine. I was scheduled to take a four-ship flight out for formation practice, and since this was the final trip prior to formation checkout for all of the students in the element, I believed this would be just another mission.

"As it turned out, I was completely wrong. For even though the Air Force furnishes almost everything in the way of equipment, a crystal ball is not standard-issue equipment.

"As a matter of fact, it *was* a routine flight until we headed back for the field and started our letdown in normal formation.

"The flight had been briefed prior to the mission that if time permitted we would make a high speed pass across the base before entering the traffic pattern.

"A fuel and oxygen check was made at 10,000 feet, and everyone had sufficient oxygen, while the fuel supply ranged from about 160 to 170 gallons in each ship. So far everything was normal, so I called traffic control and requested a pass across the field in formation at 3500 feet. Permission was granted.

"We came across the base at 3500 feet indicated altitude with the airspeed pegged at 360 knots. At the far end of the field we pulled up in a climbing turn to the left and the formation was put into echelon. Power was reduced to 80 per cent at this time.

"We continued the turn until we were on the outside downwind and dropped on downhill to 1200 feet above the terrain. This put us in a position to swing around again for initial approach. I had the flight slow down a bit more, to about 290 knots, then called for 'dive flaps down, now . . . push it up to 90 per cent.'

"Upon completion of this last call, I rolled into a 40-degree bank to the left. After swinging around for about a quarter of a turn I looked to the right to check the position of the flight, and it was then that I realized that No. 3 man was out of position.

"I can't actually recall whether he was a bit forward or high. I do know that I could see almost all of his airplane and that I realized only the tail should have been visible. Instinctively the thought flashed through my mind that here was trouble.

"The next few moments are merely blurred impressions in my mind. I think they always will be. The No. 2 and No. 3 aircraft appeared to be running together, and I knew there was no way to duck out of the way. A collision was inevitable; and just that fast it happened.

"I was slammed around in the cockpit in a completely confusing manner. Then things became almost black. Maybe it was the impact shock. I don't know. I could feel and hear but I couldn't see.

"It seemed to me that the airplane was snapping or rolling over and over. First I experienced a terrific amount of G forces and seemed to be thrown against the left side and up toward the canopy. Next, the G forces were reversed, becoming unquestionably negative in nature.

"I thought right then that 'This is it. I'm too low for an ejection — there just isn't time.' I reached down, trying to get hold of the right armrest, and at first was unsuccessful. The suddenly reversing G forces were throwing me back and forth so that I couldn't get hold of a thing.

"I guess it's funny how your mind works during an emergency. I wanted to blow the canopy, but I couldn't get the left armrest up. In fact, I couldn't touch it, and I knew that I'd never be able to pull the manual jettison handle back even if I could get hold of it. There was just one thing left to do.

"When my hand finally got the right armrest it was already up, but I don't recall pulling it to that position. I believe that probably the collision impact had broken the armrest and it had sprung up into the raised position. The only thing I had to do was squeeze the trigger. I grabbed it and did just that.

"I know that my body was not in the proper position for an ejection. I couldn't get my feet in the stirrups and I wasn't able to brace my head at all. I think that my feet were off the rudder pedals, for, as I remember it, they were just hanging in space, and I was more or less suspended from the seat belt.

"I can't remember any impact when the seat went off. There was an explosion, of course, but I didn't feel it, and then suddenly I realized that I

Following is a list of aircraft in which it is possble to fire the ejection seat through the canopy. It should be noted that on some aircraft it is necessary to actuate the canopy jettison controls in order to arm the seat; then if the canopy fails to separate from the aircraft, the pilot can eject through the canopy.

| *Aircraft* | *Procedure* |
|---|---|
| T-33A (series 51-9036 and subsequent) | Actuate the seat firing mechanism. |
| F-80B and C | Actuate canopy jettison controls then the seat firing mechanism. |
| F-84G | Actuate canopy jettison controls then the seat firing mechanism. |
| F-84F | Actuate the seat firing mechanism. |
| F-86E (series 51-13046 through 51-13069) | Actuate the seat firing mechanism. |
| F-86D-40 and subsequent | Lift left hand grip then actuate seat firing mechanism. |
| F-86F (only if T.O. no. IF-86-161 complied with) | Lift left hand grip then actuate seat firing mechanism. |
| F-86H | Check Dash-One for details. |
| F-89 (all models) | Actuate the seat firing mechanism. |
| F-100A | Check Dash-One for details. |

was out of the plane. I don't remember any sensation of going through the canopy and I don't remember if I even thought of my lap belt. I do know that I didn't try to unbuckle it. Luckily I was wearing an NA-1 type and it released automatically after a couple of seconds.

"I reached for the D-ring and don't recall any trouble in finding or pulling it. The next thing that I can remember clearly was the feel of the shroud lines tangling around my right leg as the chute was coming out of the pack, and I don't recall any hard opening shock.

"All of this time I couldn't see a thing. I had no vision whatsoever until that beautiful umbrella opened. Then, all of a sudden I could see the canopy, and I turned and looked at the ground and began to realize that I was alive after all.

"My drift was backwards at the time of impact but the landing shock was very slight, and it took but a moment to get out of the harness. I was down and intact.

"In looking back now, I sincerely believe that there were several factors that were effective in saving my life. Perhaps these points may be worth passing on to others.

"I was flying with my visor in the down position, although I don't believe it was full down and latched. I had an oxygen mask that was two or three days old. It was very tight. In fact, it was too tight.

"The chin strap was not attached to the helmet. The mask itself was equipped with a spring clip which was utilized, being attached to the mask.

"My helmet came off sometime after I left the airplane, although I don't know when, but I'd certainly be a goner if I hadn't been wearing one. The helmet showed severe damage where my head apparently penetrated the canopy glass.

"I know there's been a lot of discussion lately about parachutes. Apparently some people believe that the seat pack is best. Others go for the back pack. It seems to me that such a choice would rest mostly with the size of the pilot. Being of medium build I prefer the seat pack. In fact, I was wearing a 28-foot seat pack when I bailed out and it worked just fine.

"Like everybody else, I've always wondered if it would be possible to bail out at low altitude. After this experience I *know* that it can be done. Of course I didn't have my belt and shoulder harness unhooked. As I said before, I just didn't have time.

"I was thinking about altitude though. We were at 1200 feet when the collision occurred and I know that the time lag must have been very short from the moment of impact until I was out, but, it seemed like an eternity. I do know though, that I *got out of the plane at about 800 feet above the ground.*

"I'm sorry that I can't give a more accurate picture of the attitude of my T-bird when I ejected. The aircraft felt to me as though it were tumbling end over end or rolling over and over. Either one may have been possible for the whole tail section, including the engine, had been torn away.

"I can state positively that I owe my life to two things: First, that *I was able to eject through the canopy and second that the automatic seat belt functioned.* If it hadn't been for the automatic features of the belt I wouldn't have had time to go through the usual procedures of unhooking and kicking free of the seat. The helmet itself is proof that it saved my head from a terrific blow, for it is split down the back and on one side.

"Although I did get scratched up a bit in this caper, actually I didn't realize that I had been injured at all until I'd been on the ground for about 15 minutes.

"It was then that I noticed that my right knee was cut. I had abrasions on both shins that ran down across the tops of my feet. I had flight boots on when I jumped and for some reason they didn't come off, but the inner lining of the right boot is pretty well ripped and torn.

"I caught a few more wallops too but believe me, I'm not complaining one bit. I still have abrasions on both elbows, the right arm and leg of my flying suit was ripped and I've got a beautiful bruise about the size of a baseball right at the base of my neck.

"Incidentally, I'm sure I got the leg abrasion from the canopy rather than from under the instrument panel even though I wasn't positioned right for the bailout.

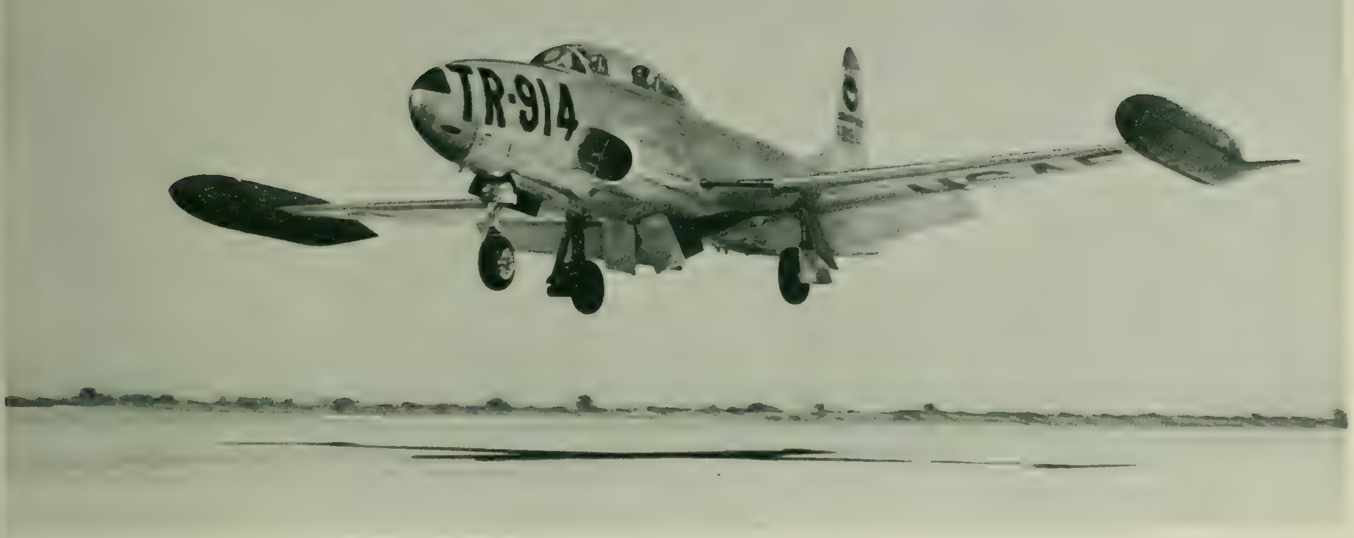
"Well, I guess that's about it. Only one thing more that may have helped a bit. My seat chute was equipped with the new type foam seat cushion and heavy kidney pads in the back, and I think that may have helped, for my back feels fine."

It is hoped that the foregoing will help to explain one experience in ejecting through the canopy at low altitude. It can be done. Certainly this officer was lucky, for the odds were pretty much against him when we consider altitude, attitude and airspeed. Go through the canopy when the terrain clearance is at a minimum. *It works!* ●

**QUIZ ANSWERS**

| | |
|---|---|
| 1 — 16,080 | 6 — 25,420 |
| 2 — 13,960 | 7 — 28,020 |
| 3 — 13,330 | 8 — 1100 |
| 4 — 10,700 | 9 — 11,000 |
| 5 — 34,640 | 10 — 11,100 |

# the LOUD silence



FLAMEOUT... a word all jet pilots well know. It's a word that is easily defined, too. No more fire. No more push. No more engine. Perhaps the best description of all was that of a young jet jockey relating his experience after several futile airstart attempts, "It was silent. Really silent. I never heard a silence so loud."

It was quiet, he was alone, and perhaps he was a mite uncertain as to just what he was supposed to do.

That's where the definition may vary slightly from pilot to pilot. A pilot who has practiced, who knows the proper procedures used in a flameout landing, has confidence in his ability to handle the emergency. He has an SOP and follows it. The man with no simulated landings under his belt, and with an incomplete knowledge of flameout procedures, may have another version of the term. To him a flameout is synonymous with trouble. Real bad trouble. He doesn't know his aircraft's high key point, low key point, best glide speeds or any other of a wealth of information that could have been learned through practice and study.

Fortunately, the latter pilot is in the minority. Nowadays, most jet drivers are firm believers in practicing flameout patterns and landings in their go-buggies.

At the request of the Directorate of Flight Safety Research, the Air Research and Development Command ran a series of simulated flameout patterns for various jet fighters during the past several years. The results of some of these tests have been published in previous issues of FLYING SAFETY; the results of tests of later models are incorporated in this article along with the earlier information.

The basis for the claim that this research has paid off in terms of aircraft dollars saved, is in the letters received from many USAF major commands, outlining the number of successful (minor or no damage) forced landings accomplished in each command.

These figures, coupled with data researched by the Directorate's Records and Statistics Division, indicate that the U. S. Air Force-wide "practice" or simulated flameout landing program has been very successful.

By comparing two periods of time, one before the simulated flameout program was instituted and one after it had been in operation for a year, it was proved that the accident rate in this category decreased 29 per cent in the second period. This point is emphasized further by the fact that although total jet flying hours increased 48 per cent in the second period, the dollar loss increased only 11 per cent, an estimated saving of several million dollars. Because of 175 successful forced landings during both periods, the savings in airframe costs alone is estimated at nearly 20 million dollars.

The study of jet flameouts is not static. It is set up on a continuing basis by Air Research and Development Command in order to obtain ultimate information on jet flameout landings under all conditions in present and future jet fighter types. In addition, the Directorate of Flight Safety Research continues to study and recommend new techniques, based on thorough analysis of jet fighter accidents. This information will be disseminated to pilots through Pilot's Handbooks, magazine articles and other printed media.

In the past, flight tests were conducted at Edwards AFB to determine the best possible procedure in flameout landings for F-84G, F-86E, F-86D and F-94C aircraft. Recently patterns were established for the F-86F, the F-84F and, in part for the F-89D, and are included in this article, along with some new data on the F-94C.

In the analysis of this information it was discovered that certain basic changes would improve the previously recommended landing patterns.

## ACTUAL FLAMEOUT DATA

| | F-84G | F-84F | F-86E | F-86D | F-86F | F-94C | F-89D |
|---|---|---|---|---|---|---|---|
| Best Glide IAS—Kts. (gear up) | 190 | 225 | 185 | 185 | 185 | 185 | |
| ** Rec. Rate of Turn—Degree/Sec. (gear up) | 3 | 3 | 3 | 3 | 3 | 1.5 | |
| *** Rec. Alt. for Lowering Gear (normal system)—Ft. | 12,000 | **see note | 12,000 | 12,000 | 12,000 | 15,000 | 10,000 |
| Avg. Time for Gear to Lock Down—Seconds | 25 | 7 to 8 | 15 | 27 | 27 | 19 | |
| High Key Alt.—Ft. | 5500 | 6000 | 6000 | 6500 | 6000 | 6000<br>8000 | ****<br>7000 |
| Best Glide IAS—Kts. (gear down) | 180 | 220 | 185 | 160 | 185 | 175 | 155 |
| Rec. Rate of Turn—Degree/Sec. (gear down) | 3 | 3 | 3 | 3 | 3 | 1.5 | |
| Low Key Alt.—Ft. | 2500 | 3000 | 3000 | 3500 | 3000 | 3000<br>4000 | 3000 |
| Base Leg Alt.—Ft. (270 degree point) | 1300 | 1500 | 1500 | 1500 | 1500 | 2000 | |
| * Rec. Final Approach IAS—Kts. | 150 | 200 | 150 | 150 | 155 | 160 | 140 |
| * Rec. Over the Fence IAS—Kts. | 140 | 140 | 130 | 135 | 135 | 140 | |
| Avg. Test Time from High Key to Touchdown—Minutes | 2.2 | 2.2 | 1.7 | 1.8 | 1.8 | 3.3 | |

* Assuming no wind and approximately 600 lbs. of fuel remaining.

** Completely elastic, depending on position and altitude.

*** Only if field is definitely within gliding distance.

**** Limited data available as complete flameout tests not run. Figures are those recommended by Edwards Flight Test Center and WADC. All figures are based on engine windmilling with hydraulic pressure available.

The major change was the modernization of the circular (360-degree over-head) landing pattern and the readjustment of key point altitudes as shown on the accompanying charts.

In addition, the Edwards AFB test report stated that the hydraulic irreversible normal flight control system on F-86E and F-86D airplanes is fully operable with the power provided by a windmilling engine.

Improvement of the pattern used in the early flameout landing study as prepared by the Directorate of Flight Safety Research was recommended by test pilots at Edwards AFB. This revision called for three pattern points with corresponding altitudes, rather than the two points used in the original tests.

The first or "High-Key" point remains in the same geographical pattern location and is established on the initial approach at a specified airspeed and altitude with gear down and locked.

## FLAMEOUT SIMULATION DATA

| | F-84G | F-84F | F-86E | F-86D | F-86F | F-94C |
|---|---|---|---|---|---|---|
| Best Glide IAS—Kts. (gr. up) | 190 | 225 | 185 | 185 | 185 | 185 |
| Best Glide IAS—Kts. (gr. dn.) | 180 | 220 | 185 | 160 | 185 | 175 |
| Avg. Power-RPM-%—25,000 to 12,000 Ft. | 65 | | 72 | 79 | 68 | 79 |
| Avg. Power-RPM-%—15,000 to S.L. (gr. dn.) | 58 | | 69 | 74 | 64 | 69 |
| * Rec. Alt. for Lowering Gear—Ft. | 12,000 | ...... | 12,000 | 12,000 | 12,000 | 15,000 |
| Rec. Rate of Turn—Degrees/Second | 3 | 3 | 3 | 3 | 3 | 1.5 |
| ** Best Across the Fence IAS—Kts. | 140 | 140 | 130 | 135 | 135 | 140 |

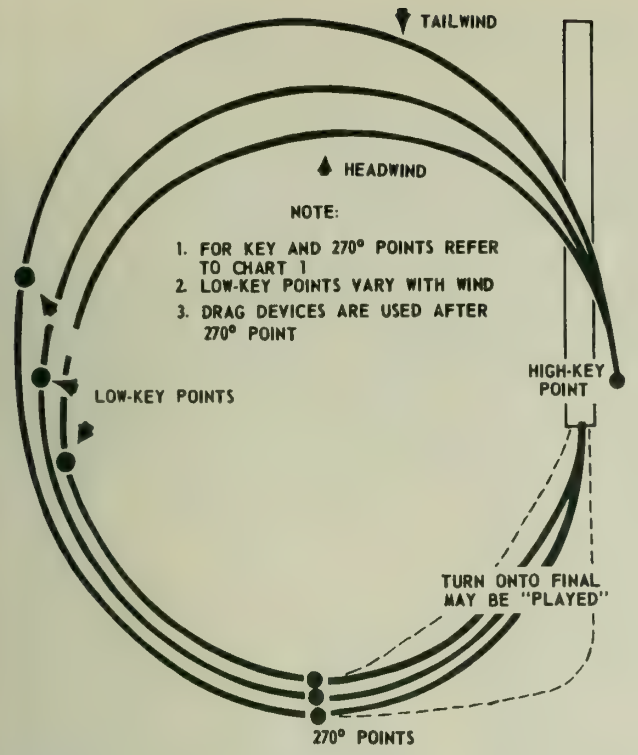
* Only if field is definitely within gliding distance.

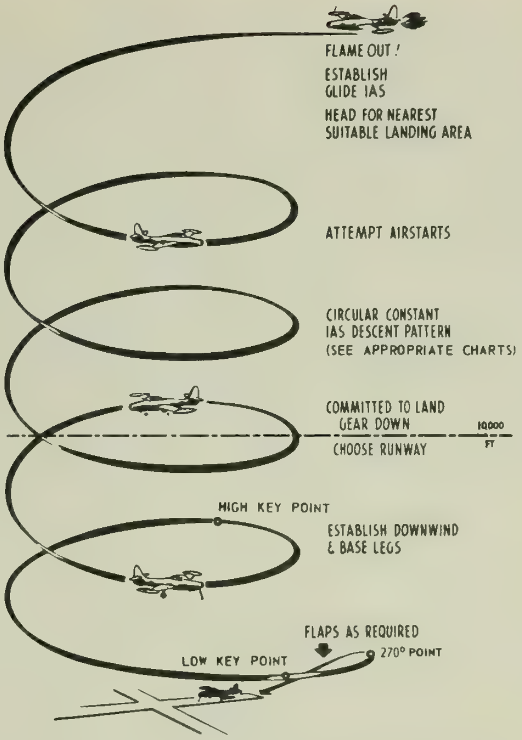
** Assuming no wind and approximately 600 lbs. of fuel remaining.

At this "High-Key" point a specific and constant rate-of-turn should be started and maintained until the 180-degree or downwind point is achieved. Here is the point where a positive decision must be made by the pilot, and depending on the prevailing wind, the pattern must be "played" from here on. As this 180-degree point is the location of resolution and is the spot where the pilot must make his first evaluation of his ability to properly hit the runway; it is known as the "Low-Key" point. The last significant altitude is at the 270-degree (base leg) point. From here to touchdown, a successful landing is effected through the proper use of flaps, speed brakes, and if necessary, controlled side-slips and fishtails. (Consult the Dash-One T. O. for slip restrictions on your aircraft.)

The aiming points on the runway remain unchanged. For a headwind condition, shoot for the midpoint of the runway; if a tailwind prevails, shoot for the first third of the runway. But the important thing is to put the plane where you want it.

As in all flying techniques, there must be a flexibility of patterns to conform to the hundreds of varying conditions. The figures shown in the charts on this page are for optimum conditions only, in the sense that the


TAILWIND
HEADWIND
NOTE:
1. FOR KEY AND 270° POINTS REFER TO CHART 1
2. LOW-KEY POINTS VARY WITH WIND
3. DRAG DEVICES ARE USED AFTER 270° POINT
LOW-KEY POINTS
HIGH-KEY POINT
TURN ONTO FINAL MAY BE "PLAYED"
270° POINTS



resulting pattern is easily flown and gives accurate results.

It is possible to perform the entire 360-degree pattern at altitudes different from the values shown, depending upon the judgment of the pilot. If you happen to come out at the "High Key" point at an altitude lower than that specified, it is possible to complete the approach by making a smaller pattern with accompanying increased rates of turn. However, these steep, tight turns can become uncomfortable with boost off.

At this point the difference between emergency and forced landings should be emphasized. The following descriptions of a "forced" and an "emergency" landing still hold good.

An emergency landing is a precautionary landing made at the pilot's election, and under conditions where he has control of his power and of his flight controls.

A forced landing is a landing under conditions where loss of power control or partial loss of flight controls precludes further flight.

A word about canopies. Follow the Dash-One to the letter as to whether you should jettison or open your canopy on a forced landing. In the event of a wheels-up landing, or if an undershoot or overshoot occurs on a wheels-down landing and fuel spillage is a probability, do not jettison the canopy as firing of the mechanism will ignite the fuel. In this case, open the canopy manually or have it jettisoned before touchdown.

The recorded experiences of over 600 jet fighter pilots who have evacuated crashed aircraft indicate clearly the desirability of pre-crash canopy removal. Of these pilots, 110 experienced difficulty in canopy removal following a crash landing. As a direct result of post crash fires, six received fatal and seven received major burn injuries. Eight others were saved only by the prompt action of crash crew personnel. An analysis of these accidents proved conclusively that the majority of crash landing injuries were not caused by impact forces, and prompted the recommendation to jettison the canopy prior to execution of a forced landing.

Here is another moot point which you F-86E, F and D jockeys had better paste in your helmet. Comes a turbine seizure (and you will know it when you get complete, *but complete,* loss of rpm), get ready to go over the side. Of course if you are over an established airfield at a fairly low altitude, and you are sure that you can make the field, then best you ride it down. Remember though, in the F-86E, F and D models without engine windmilling, your alternate flight control is dependent on the battery and the battery may last only a few minutes. This information also applies to the F-84F-25 and subsequent aircraft. The F-84F-1 to 20 can be flown without hydraulic pressure because the controls contain mechanical linkages to the surfaces. The F-84F-25 and up can be considered, for this purpose only, just like the F-86F. The same advice, and experience shows it is really good advice, holds true for pilots flying the F-89-B, C and D models. In the unlikely event that you lose both engines and can't maintain sufficient windmill speed, be prepared to leap.

Another point along this line. With a seized turbine your rate of sink increases about 35 per cent over normal gliding ratio.

We cannot stress the point too strongly that the information contained in the studies of flameout landings be used constantly in the education of jet pilots, regardless of their experience level. These facts should be impressed indelibly on the mind of every man who flies a jet, until his reactions in making a flameout landing become natural reflexes.

This is one time when practice really counts. So it's up to you . . . only *you* know if you're proficient. ●

# Ask The Man Who HITS One!

*Barrier!*

That's a word which is coming into every day usage more and more. You mention barrier to hot-rock Charlie or John Q. Public and they both think of that invisible wall. The sonic barrier is fast becoming an open door in spite of its name.

There's another type of barrier though that isn't quite as well known and this one is plainly visible. These barriers, unlike the sonic type, do not present any particular problem when an airplane slams into them. It's exactly what they are intended for. As a matter of fact, driving headlong into one of these arresting gears can mean the difference between a successful stop or a badly mangled aircraft. That is if a pilot overshoots a flame-out landing, suddenly runs out of brakes during the landing roll or loses the fire-pot on takeoff.

In terms of dollars saved, the units now in operation are paying for themselves many, many times over. And within the next few months more new units will be springing up all over the world, until eventually almost every USAF air base will have one or more.

FLYING SAFETY used the program now in operation at Nellis AFB as an example of how the barrier works. While not the first, it was one of the first in the ZI. Incidentally, all Crew Training Air Force bases now have barriers installed.

The Korean conflict established the value of barriers in fighter operations. The many saves in that theater indicated that a barrier was a must in an accident prevention program.

We do not intend to go into any of the finer details of the emergency arresting gear in this article. That is strictly an Air Installations problem and will be so handled by bases scheduled for these units. However, we do want to alert pilots of fighter aircraft to the fact that an extensive program is already under way and point out a few operational factors that are worth remembering.

A brief rundown on the main features of the barrier should help to better understand its operation.

In general, the following components make up a typical arresting gear:

*Webbing Assembly*—This assembly consists of an actuator strap to which are attached a number of vertical lifter straps. Each lifter strap is rigged to the arresting gear cable by means of six special lock type snap fasteners. These fasteners can carry a high load. The restraining strap, which is secured to the anchor end of the vertical lifter strap by two conventional glove type snap fasteners, is incorporated as a part of each lifter strap to insure that only a load of high magnitude will have a tendency to open the six main fasteners.

Five gets you ten that we lost you on that one. But, as it's not our intention to add confusion to this article just think of a nylon net, anywhere from 150 to 400 feet long and 40 inches high. That is a rough picture of the webbing assembly.

*Releases*—Two release devices are used to attach the ends of the actuator straps of the webbing assembly to the tension mechanism of the arresting gear stanchions. A replaceable shear pin is incorporated in the release and upon shearing, the actuator strap is freed from release assembly.

*Runway Anchors* — These anchors provide a means of anchoring the lifter straps to the runway. It is from these points that the restraining force is applied that unsnaps the six main fasteners on each lifter strap thus releasing the arresting gear cable during engagement.

*Arresting Gear Cable* — A flexible steel wire rope cable, $\frac{7}{8}$ inch, uncoated, improved plow steel, fibre core, is utilized as the arresting gear cable. This is the little gem that snaps up and grabs the blow-torch firmly by the landing gear. Each end of this cable is attached to the arresting chains.

*Arresting Chain*—This is the part of the barrier assembly that does the actual slowing down and stopping of an aircraft. The chain is placed parallel to both sides of the runway. At Nellis AFB they are using 273 feet of chain on each side and as each link weighs 57 pounds, it is apparent that any engagement means dragging a lot of weight.

*Main Stanchions* — The stanchions, mounted on concrete foundations, serve as end supports for the actuator and arresting cables. Each stanchion incorporates a hand operated winch for tensioning the actuator pendants. These stanchions, hinged at their bases, incorporate a cable with shear pins installed, instead of the old system of bungee cords. When aircraft contact the arresting cable, the shear pins break and allow the stanchion to bottom. Old tires are placed on

If a pilot overshoots on a flame-out landing, runs out of brakes after touchdown or loses his fire on takeoff, his best friend may well be the crash barrier.

the concrete bases to prevent damage when the stanchion is flattened to the ground. The stanchions can be laid flat when the barrier is not in use.

Originally, the Nellis installation used intermediate stanchions to serve as supports for the webbing assembly. Now, pieces of soft, white pine wood, 1½ inches in diameter, have been substituted for the stanchions. The wood poles are stuck into pipes sunk in the ground and are notched at the top. The top of the webbing is inserted in the notch and supported by the pole. The wood breaks when the barrier is engaged.

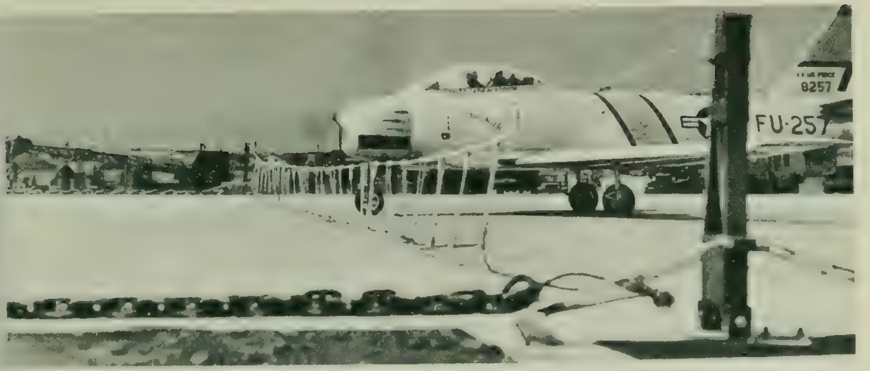
### Barrier Operation

You're probably wondering at this point just how this little beauty works. We'll try to keep it simple. Between this copy and the pictures, you should be able to get a pretty fair idea.

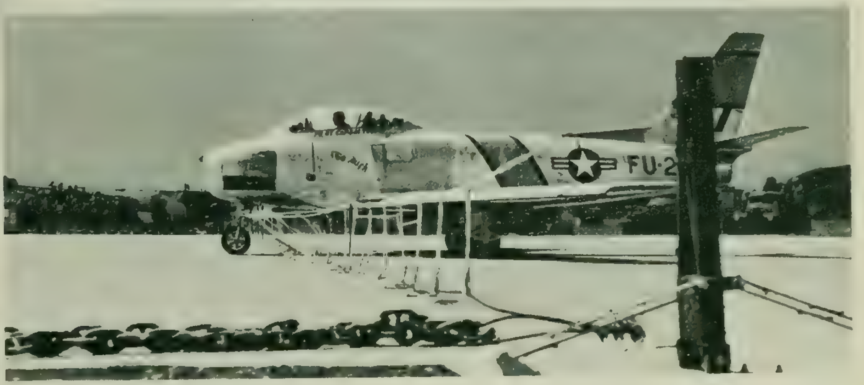
As the nosewheel passes over the arresting gear cable lying on the runway, the webbing assembly is engaged by either the nosewheel strut fairing or the nosewheel well doors.

Continued forward motion results in the arresting gear cable being lifted off the runway by four lifter straps in such a fashion that the arresting gear cable rises *behind* the nosewheel, but *in front of* the main landing gear.

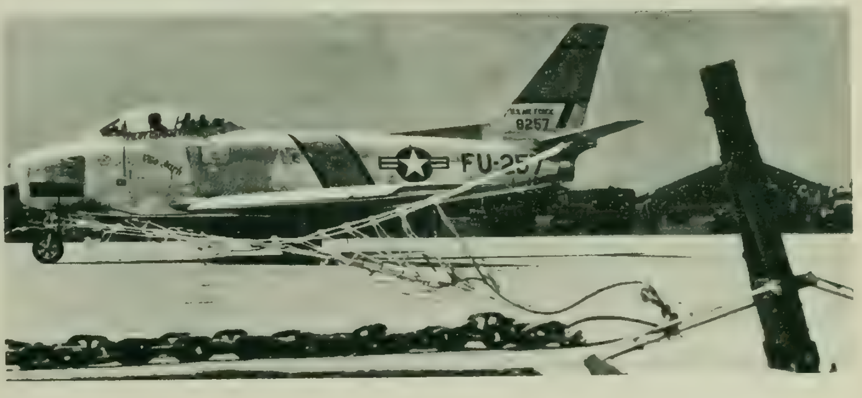
The four active lifter straps continue to lift and pull forward on the cable until they are taut between the nosewheel fairing and the anchors. Further forward motion unsnaps the retaining snap fasteners, pulls the



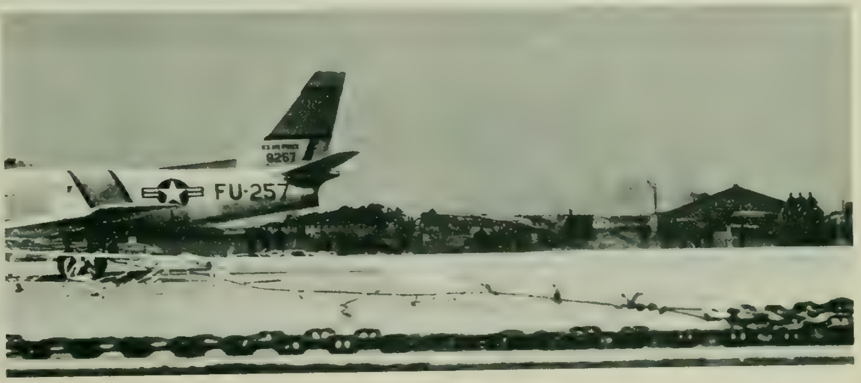
An F-86 moves down the runway and is shown prior to and immediately after initial contact with nylon webbing. Arresting cable will spring up to engage main gear.



After nylon webbing is torn away by the nose gear and arresting cable has engaged the main landing gear, the pilot can expect the speed of the aircraft to diminish.



With the arresting cable now positioned and pulled taut, the aircraft begins to drag the heavy, linked chains which are stretched along both sides of the runway.



lifter straps through the inertia flaps, then unsnaps the six main snap fasteners on each lifter strap.

At this point, the arresting cable is off the runway, moving upward and slightly forward between the nosewheel and the main gear and is completely free of the lifter straps.

As the aircraft continues forward, the arresting gear cable is engaged by the main landing gear struts and further forward motion is restrained by pull on the cable transmitted from the arresting chain. The airplane then progressively moves more mass by reeling out the heavy doubled chain during the remainder of the arresting run. We did a bit of research and asked a lot of questions on the actual operation of the Nellis AFB barrier.

It is interesting to note that as this issue goes to press, six aircraft have been saved from almost certain destruction by the Nellis barrier. Add that up in dollars and you'll see that the $5,000 or so spent on its construction is but a drop in the bucket.

Unfortunately, three more aircraft failed to engage the barrier because the pilots did not establish the proper configuration for their aircraft, or didn't use the proper techniques. All external stores other than tiptanks must be jettisoned, and pilots should *not* use the brakes in an attempt to slow down.

Here is a description of some of the saves made at Nellis AFB:

- The pilot of an F-86F started his takeoff roll as the No. 2 man of an element. He ran up to 98 per cent and went wheeling down the runway.

As the leader became airborne the No. 2 man noted that his plane was dropping back. He glanced at the tailpipe temperature gage and saw that it was rising above the red line (700°). The pilot immediately stopcocked the throttle and aborted the takeoff. The airspeed indicator was crowding 150 knots at this time.

At Nellis the 23-foot drag chain is made up of 57-pound links, each over a foot long.

As brakes were applied, the plane began to slow somewhat, but it was evident that insufficient runway was left for a safe stop. At 100 knots the F-86 slammed into the barrier and decelerated to a stop with only minor damage inflicted by the barrier cable. Chalk up one save for the runway arresting gear.

We don't propose to go into the cause factors of these cited incidents. The important thing is that the barrier saved these planes from almost certain destruction.

- The pilot of an F-86F was returning to the base from an air-to-air gunnery mission. His landing was fast because he inadvertently left the emergency switch in STANDBY position. This forced an idle condition of approximately 42 per cent and the pilot found it impossible to slow the plane to normal touchdown speed.

Mobile Control observing the fast approach, instructed the pilot to "take it around." However, on advancing the throttle a compressor stall occurred and a forced landing suddenly became a reality.

The F-86 engaged the barrier at an estimated 70 knots. Only the right gear connected with the cable but in spite of this the pilot was able to maintain straight directional control and the plane was stopped without any appreciable damage.

Chalk up another on the plus side for the barrier.

- The pilot of this F-86F was No. 3 in a flight of four Sabre Jets that had just completed a routine training mission. His trouble began on the first landing attempt. He messed up the pattern and Mobile sent him around for another shot at it.

While tooling around the pattern on his second landing attempt, the pilot noticed that the throttle was not functioning properly. On final he discovered that power could not be reduced below 70 per cent rpm. This was like having the well-known tiger by the tail and from this point on the pilot was committed to land regardless of any personal desires.

The plane touched down at about the midpoint of the runway and went into the barrier at 140 knots. It was stopped in less than 500 feet with only minor damage to the fairings. After the dust settled the pilot finally cut the master fuel switch to stop the engine. Obviously, the value of the Nellis barrier is increasing.

- This one was a bit different in that it involved a T-33A, and the plane went sizzling into the barrier with the speed brakes down. Normally you'd expect the speed brakes to force the barrier cable down and below the main gear. Fortunately this didn't happen as the cable was forced downward and then snapped up again to engage just the tips of the wheel fairings. 'Twas enough though, and the plane was stopped successfully. However, the pilot was extremely lucky as normally the barrier will not engage with speed brakes down.
- In another instance, an F-86 hit the crash barrier while traveling at high speed and a successful engagement was made. In this case, however, the pilot did not get rid of the external tanks prior to barrier impact. He was lucky. The cable wrapped around the pylons instead of the landing gear, but damage was negligible.

## Quick Stop Tips

There are a few things that the pilot can do to insure maximum effectiveness when engaging the barrier:

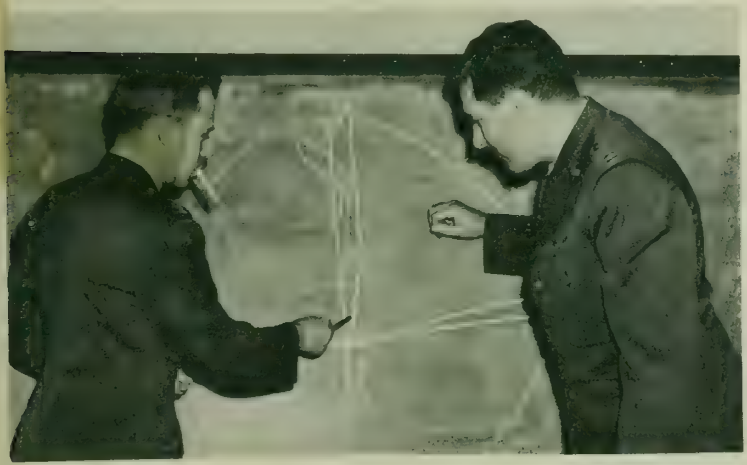
- If an emergency develops in the landing roll-out or on a takeoff run, the pilot should make every effort to strike the center of the barrier, holding the airplane on a heading as closely parallel to runway as possible.
- Excessive braking action to a point where a tire may blow out or cause the plane to swerve must not be used as this probably will result in an improper engagement of the barrier, or even in hitting the barrier sideways. Also, tests indicate that a high speed impact has a distinct advantage over a slow speed roll-in in picking up the arresting cable.
- F-84s with pylon tanks and F-86s with external tanks should be cleaned up prior to impact if at all possible, i.e., drop all stores and external tanks other than centerline tips.
- Pilots flying F-80s, T-33s, F-100s or other types with speed brakes located below the fuselage should make every effort to retract the speed brakes prior to impact, as the speed brakes will deflect the arrester cable downward and prevent engagement.

Remember, the barrier will save the day for you in an emergency. Keep the few simple steps for engagement filed away in your mind. Work *with* the barrier when the chips are down and it'll take care of you. ●

# YOU need these men!

Don't wait for an accident to happen! Officers trained in all phases of accident prevention and investigation at the Flight Safety Officer Course, USC, can save commanders many headaches.

Part of the accident prevention program consists of working with AACS and operations personnel. These officers are highly trained investigators.



Nowadays the advertising world is full of copy aimed at prevention. We read ads on preventative medicine, on methods to avoid being socially ostracized, on newer and better cars and automotive equipment designed to prevent accidents.

Our "ad" is aimed at USAF commanders and admittedly follows this trend. Only we believe we have the most valid claim of all. Our campaign slogan might well be "Don't wait until an accident happens."

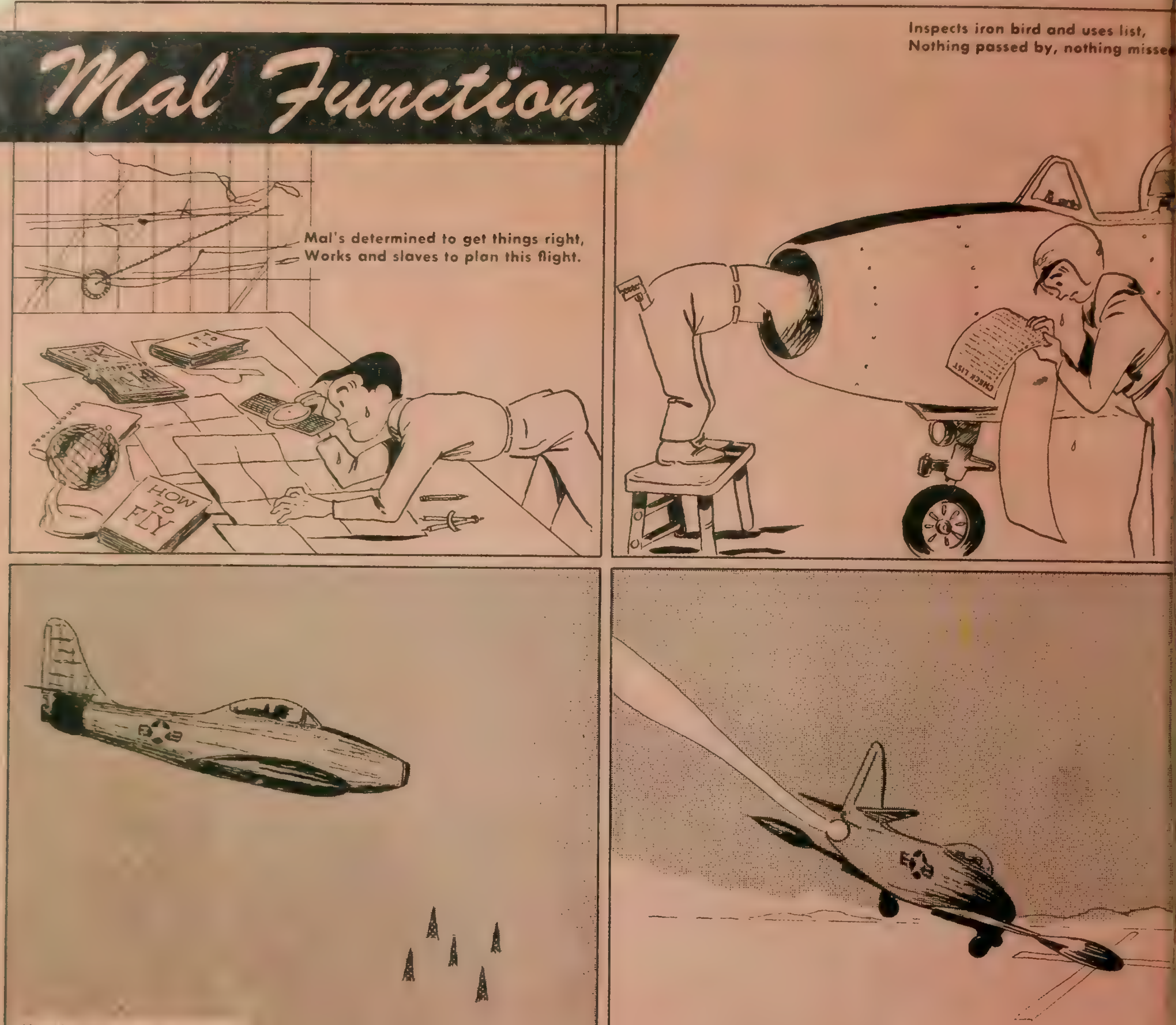
Right now, highly trained Air Force officers (221 graduates to date) are available to commanders in the accident prevention field. These men can save you a lot of headaches. They are graduates from the Flight Safety Officers' Course at the University of Southern California.

This comprehensive 8-week course trains Flight Safety Officers in both accident prevention and accident investigation. Following is the course curriculum:

| COURSE | HRS. |
|---|---|
| Engineering | 89 |
| Aircraft Accident Investigation and Prevention | 90 |
| Physiology | 24 |
| Psychology | 30 |
| Education | 28 |
| Public Speaking | (8) |
| Writing | (4) |
| Graphics | (2) |
| Techniques | (14) |

| COURSE | HRS. |
|---|---|
| Trip to Directorate, Flight Safety Research | 7 |
| Field trip to representative aircraft factory | 7 |
| Demonstration of Centrifuge | 3 |
| Evaluation Orientation and graduation | 5 |
| Total Hours: | 283 |

# Mal Function



Mal's determined to get things right,
Works and slaves to plan this flight.

Inspects iron bird and uses list,
Nothing passed by, nothing misse

How he did it, who's to say,
He stayed on course, hit ETA.

Mal's low approach is on the ball,
Runway lined up, no sweat at all.

An icy runway was the cause
For Mal's fast pass on Santa Claus.

Alas and alack, 'twas all in vain,
Mal forgot about freezing rain.

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